THE GEOGRAPHICAL JOURNAL

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NOTICES

PROGRAMME OF MEETINGS

Thursday September 17

SYMPOSIUM ON CERTAIN ASPECTS OF PHYSICAL OCEANOGRAPHY. *Chairman: Dr. Edward Hindle,* F.R.S.

10.00 *a.m.* The configuration and evolution of oceans, continental shelves, etc. *By Dr. J. D. H. Wiseman* (*British Museum of Natural History*).

11.00 *a.m.* Movements on beaches and other coastal changes involved in the interaction between land and sea. *By W. W. Williams* (*Cambridge*).

2.15 *p.m.* Water circulation in the oceans. *By J. Crease* (*National Institute of Oceanography*).

3.00 *p.m.* Recent climatic change as an ecological factor. *By A. J. Lee* (*Fisheries Laboratory, Lowestoft*).

3.45 *p.m.* Hydrography and the Fisheries. *By Dr. J. B. Tait,* F.R.S.E. (*Fisheries Laboratory, Aberdeen*).

Friday September 18, *Saturday September 19.*

SYMPOSIUM ON THE BIOLOGY AND PRODUCTIVITY OF THE SEA. Arranged by the Institute of Biology.

Friday September 18

Chairman: Professor F. E. Fritsch, F.R.S.

10.00 *a.m.* The chemistry and physiology of organic production. *By Dr. H. W. Harvey,* F.R.S. (*Plymouth*).

The measurement of the rate of organic production. *By Dr. E. Steemann Nielson* (*Copenhagen*).

Ocean fertility in relation to world oceanography. *By R. I. Currie* ("*Discovery*" *Investigations*).

Chairman: Dr. F. N. Woodward

2.00 *p.m.* Methods of investigation of marine organisms. *By G. A. Steven* (*Plymouth*).

Distribution of marine organisms. *By Dr. N. A. Mackintosh* ("*Discovery*" *Investigations*).

Marine algae and their exploitation. *By F. T. Walker* (*Institute of Seaweed Research*).

Marine phytoplankton and their exploitation. *By Dr. C. E. Lucas* (*Marine Laboratory, Aberdeen*).

Saturday September 19

Chairman: F. S. Russell, F.R.S.

10.00 *a.m.* Demersal fisheries. *By Michael Graham* (*Fisheries Laboratory, Lowestoft*).

Colonial fisheries. *By M. L. Parry* (*Fisheries Officer, Malaya*).

Whales and seals. *By R. H. Clarke* ("*Discovery*" *Investigations*).

Shellfish and sponges. *By Dr. H. A. Cole* (*Fisheries Experiment Station, Conway*).

Chairman: H. J. Johns

2.00 *p.m.* The use of fertilizers and the direct harvesting of plankton. *By Professor J. E. G. Raymont* (*University of Southampton*).

Fish farming. *By Dr. C. F. Hickling* (*Colonial Office*).

World food problems and the sea's contribution to their solution. *By Dr. D. B. Finn* (*Food and Agriculture Organization*).

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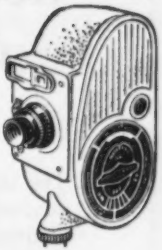

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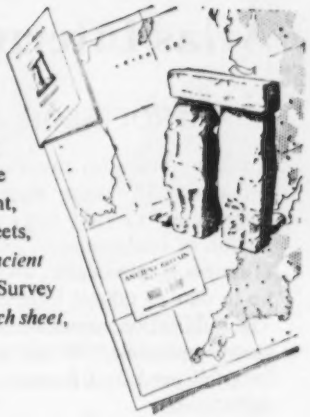

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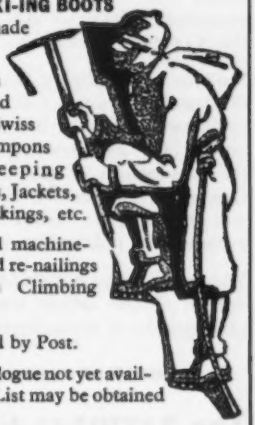

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The
GEOGRAPHICAL JOURNAL

Vol CXIX Part 2 *June 1953*

THE EXPEDITION TO CHO OYU

ERIC SHIPTON

WHEN WE RETURNED to England in December 1951 with the information that there was a practicable route up the southern side of Mount Everest, it was thought that this discovery would be followed immediately by a British attempt to climb the mountain by that route in the Spring of 1952. However, it was found that the Swiss had made a previous application to the Government of Nepal for permission to send an expedition for that purpose, and that their preparations were already almost complete. A proposal to launch a joint Anglo-Swiss expedition under joint leadership was thought by the Himalayan Committee to be impracticable, and it was decided to defer the British attempt until 1953.

I put forward a suggestion that the 1952 season might profitably be used by sending an expedition to attempt the ascent of Cho Oyu, a 26,800-foot mountain lying some 20 miles west of Everest. Apart from the interest of the ascent itself, the expedition would, if it succeeded in reaching any great height on the mountain, serve several most important purposes: to test the ability of a number of mountaineers to climb to great heights, and to provide a nucleus of men with experience of working at extreme altitudes for an Everest team; to carry out experiments in the use of oxygen apparatus; to study physiological problems of high altitude climbing, such as acclimitization and deterioration, diet and liquid consumption; and to test clothing and equipment. At least the expedition would provide the party with valuable training and experience of Himalayan conditions. The Committee accepted the proposal.

My reason for selecting Cho Oyu as an objective was that, while searching for the Menlung La in November, Ward and I had seen what appeared to be a practicable line of ascent from the south-west. I took some stereoscopic photographs of the mountain from this angle, and when these were examined in England they seemed to confirm our observations on the ground. At the time, of course, we had no idea that we would ever have the chance of climbing Cho Oyu, and therefore for us the existence of a practicable way of climbing it from the south was of academic interest only. For this reason and because at the time we had a more interesting job on hand, we did not make a closer reconnaissance of the route in question.

Owing to the negotiations concerning Everest, the decision to send an

expedition to Cho Oyu was not taken until about the middle of January, and only six weeks remained before the departure of the expedition to make all the necessary preparations. But the organization was not difficult. Almost the only money available was the residue of that earned by the Everest Reconnaissance Expedition, though later *The Times* contributed a further £1000. Lack of funds therefore enforced both extreme economy and simplicity, and only the bare necessities could be taken. A single afternoon sufficed for drawing up a list of all our requirements in the matter of food and equipment. Fortunately, too, H. E. Riddiford, who had been a member of the Reconnaissance Expedition, was in England on a visit and undertook the work of assembling stores and equipment, and of dealing with the great volume of correspondence which even the simplest expedition seems to evoke.

Besides myself, eight climbers were invited to join the expedition: T. D. Bourdillon, E. P. Hillary, H. E. Riddiford, G. Lowe, R. C. Evans, A. Gregory, C. Secord and R. Colledge. The generosity of the Royal Society enabled Dr. G. Pugh, of the Medical Research Council, to be attached to carry out research into the problems of high altitude physiology. A party of ten in the Himalaya is grossly unwieldly and inconvenient, and I was somewhat appalled at the prospect. But obviously the chief objects of the expedition would best be served by giving as many climbers as possible a chance to prove themselves fit for inclusion in the Everest team.

When I visited Zurich in January the leaders of the Swiss expedition expressed grave concern at the prospect of two large expeditions operating in the same area at the same time. I was satisfied, however, that their fears were groundless, and undertook to travel to Namche by a different route so as to avoid competition over transport, and to arrive there later so as to afford them a free hand in the recruitment of Sherpas.

The expedition assembled at Jainagar, rail head in the Darbhunga district of North Bihar, at the end of March. Beyond this point there is no road capable of taking mechanical transport and we had to walk across the 30 miles of flat, sandy country separating Jainagar from the foothills, while our baggage was carried in ten bullock carts. This peculiar caravan set out across the Nepalese frontier, which lies immediately to the north of Jainagar, on March 31. It was terribly hot and the deep sand made very heavy going. In spite of this we soon became impatient of the funereal pace of the bullock carts and strode recklessly ahead at 2½ miles per hour. A multiplicity of interesting paths crossed the featureless land, and our choice of route differed from that of the bullock cart drivers and the Sherpas. So, when night fell, we found ourselves separated from our transport. Tired, hungry and thirsty, we found inadequate shelter in a grass shack. Thus the party received an early lesson in the hazards of Himalayan travel.

The next morning we were offered an elephant to help us on our way. This we gladly accepted, but when it came to the point, it was found that the creature had gone on another mission, and we were forced to continue on our feet. However, in the middle of the afternoon, just as the foothills were beginning to loom ahead through the dust-haze, we overtook our missing caravan, and early in the evening of April 1 we reached the village of Chisapani.

Here we spent the whole of the following day recruiting coolies to carry our

baggage to Okhaldhunga. We had about ninety 60-lb. loads, and at first it seemed as though this task would take us many days. But by noon news of our arrival had spread to the surrounding villages and men soon started to arrive. Moreover, most of them demanded to be given double loads (120 lb.) for double pay, a very fair request; so by evening we had recruited an ample carrying force.

For the next two or three days we marched through the Swalliks, that curious range of low hills, geologically distinct from the main range, which runs for hundreds of miles along the foot of the Himalaya. It was rough country, intersected by innumerable dry watercourses and covered with dense jungle, restless with the shrill noise of wild life. On April 6 we reached the banks of the Sun Kosi, which we crossed on a primitive ferry, and entered a long valley leading up into the heart of the main range.

For most of us these were carefree days of sheer enjoyment. The porters, though they went extraordinarily well in spite of their heavy loads, could not be expected to manage more than the distance that could be covered in five hours' steady walking. We started soon after dawn (five o'clock) each day and marched for two or three hours in the cool of the morning; then we chose some shady spot by a stream to cook and eat an enormous breakfast. This pleasant occupation would last until eleven o'clock, when, the bulk of the day's march already done, we would walk on in a series of easy stages to the next camp, stopping frequently to plunge into a pool, to read or to ponder on the excellence of life. Each night we slept in the open.

For Dr. Pugh, however, it was a busy time, for he had already begun his physiological studies. He marched with his rucksack bristling with test tubes and glass retorts and coiled about with lengths of plastic tubing. With tireless application he counted our heart beats, measured our haemoglobin, and recorded our liquid intake, so that no phase of our changing metabolism should escape his notebook.

In spite of our leisurely progress we took only five days instead of the scheduled seven, to reach Okhaldhunga from Chesapani, and on April 7 we climbed 4000 feet up the steep hillside to the capital of the third administrative district of eastern Nepal. Here we spent a day recruiting another batch of coolies, and paying off the first.

Our way now led northward along the crest of a high ridge, which would have commanded splendid views of the surrounding country and of the great mountains but for a persistent dust-haze which reduced visibility to a few miles. One morning, however, it was clear enough to allow us a good view of the Everest massif; and on another, while we were descending a steep, forested slope, the lovely peaks south of the Tesi Lapcha showed for a while as spectral shapes above the tree tops.

We reached Namche Bazar on April 16, the march having taken (including two days' halt) seventeen days. The Swiss Expedition which had arrived three days earlier had left for their base camp that morning. Despite the fact that they had taken nearly two hundred porters with them from Namche, I did not anticipate any difficulty in recruiting sufficient for our modest needs. But I was astonished at the extraordinary eagerness among the local population to join our expedition. We locked our baggage in a go-down while we

were paying off the Okhaldhunga coolies. An impatient mob of Sherpas gathered outside, and, fearful lest they should fail to obtain employment, they battered open the door, seized loads indiscriminately and marched off with them, many in the wrong direction. We had to struggle hard to restore order, and it was a long time before we recovered all the loads.

On April 19 we left Namche and travelled for two marches up the Bhote Kosi to Chule, from where, on the twenty-first, some of us climbed a small peak of about 18,500 feet. On the twenty-second we moved on to Lunak, which we had selected as a centre from which to reconnoitre the approaches to Cho Oyu. It is situated by the side of the Nangpa Glacier at about 17,000 feet and consists of four stone huts, two of which were roofless. These meagre buildings offer the last shelter of any kind on the route across the Nangpa La (19,000 feet) to Tibet. By the middle of April there is usually a fair volume of traffic across this remarkable pass. But that year exceptionally heavy snowfalls in the late winter and early spring had hitherto prevented the passage. The first party to undertake it was six Buddhist monks who had accompanied us from Okhaldhunga to Namche and who reached Lunak two days behind us. These were followed by a large number of Tibetans, who had been spending the winter in Khombu, where the food is cheaper and more plentiful than in their own country, and who were now returning to their still frozen lands on the high plateau. It was astonishing to see these people—men, women, children and infants carried in baskets—setting forth in the falling snow on their long glacier trek with no clothes except what they wore, with no prospect of shelter at night, and carrying only a few sticks of juniper for fuel. A week later parties of Sherpas started the crossing, mostly to buy salt at Kyetrak, though some had business as far afield as Tingri and Shekar Dzong, and there were more monks bound for the pilgrimage to Rongbuk.

Based on Lunak we spent a fortnight doing small training climbs and reconnoitring the country. Movement was handicapped by winter snow which still blanketed the whole area. The weather, too, was very unusual. In place of the cloudless skies and bitter north-westerly gales which, from previous Everest expeditions, we had come to expect in this region at this time of year, we experienced mild, thundery weather, with variable winds which were predominantly southerly. There had also been unseasonable precipitation on the high peaks. For example, the views we obtained of the north-west face of Everest showed that it was covered with snow, instead of being bare and black as it always was when we reached the Rongbuk Base Camp in April. In May, the north-west wind became sufficiently established to sweep the mountain clear of this snow.

A close inspection of the south-west ridge of Cho Oyu, upon which our hopes of climbing that mountain were based, showed beyond any doubt that it was impossible even to effect a lodgement upon it. At the same time, by climbing a 21,000-foot peak above the Nangpa La, Hillary and Lowe confirmed the report made by Murray and Bourdillon the previous autumn, that the west face of the mountain was possible. This placed us in an awkward dilemma. To launch a serious attempt upon the west face it would be necessary to establish a base just beyond the pass and to stock it with a considerable

bulk of equipment and supplies. With Tibet in the hands of the Chinese Communist Army this would be an unwise procedure. For although the frontier between Tibet and Nepal has not, in this area, been officially demarcated, a Chinese Commander in the vicinity of Tingri, hearing, as he would undoubtedly hear, of our presence so close to the frontier, would almost certainly send a patrol to the pass to find out what was going on. So far as we could ascertain, there were no Chinese in the vicinity of Tingri at the time. But in the first place news of us might spread far beyond that town, and secondly travel on the plateau is comparatively rapid, and the situation might change entirely within a few days. The consequences of meeting with a Chinese patrol were obviously too serious to risk, and we decided forthwith to abandon anything like a full-scale attempt on Cho Oyu by this route.

We did, however, establish a light camp at 21,000 feet on the face, which was occupied on May 7 by Hillary, Lowe, Evans, Bourdillon, Gregory and Secord. It was hoped that if the climbing proved really easy, some of them might succeed, in the next few days, in climbing to a considerable altitude, even if they failed to reach the top. But at an altitude of 22,500 feet they encountered a formidable barrier of ice cliffs which ran right across the face. This barrier marked the point where the upper limestone cap of the mountain rested on the granite base of the main massif. It was obvious that it would take at least a fortnight to overcome this obstacle and establish a route over it, and this would necessitate the build-up of supplies on a scale which had already been decided against. So we reluctantly abandoned the attempt to climb Cho Oyu.

Failure in the main objective is not an uncommon experience of Himalayan expeditions. Luckily there is never any lack of secondary objectives. There were still some weeks left before the monsoon might be expected. The expedition was divided into three self-contained units, each with its allotted task. Dr. Pugh, with his apparatus, was established in a camp on the Menlung La, at an altitude of 20,000 feet, where he carried out a modified programme of physiological research, assisted by Bourdillon, Secord and Colledge. A series of controlled experiments was conducted with the use of oxygen at varying rates of flow. The results of these and other experiments have produced much data relevant to the solution of the problems of acclimatization and deterioration. When this work was completed, Bourdillon and Colledge climbed the central peak of the area, a beautiful mountain 22,400 feet high, which has been named Pangbuk. The party then travelled southwards and succeeded in crossing a new pass from the Menlung basin to the Rolwaling.

Before leaving the area west of Cho Oyu, Hillary and Lowe climbed three peaks in the vicinity, two of about 21,000 feet, and a third of 22,600 feet. They then returned to Namche, from where on May 19 they started up the valley of the Dudh Kosi with three weeks' food, to make an attempt to cross the Nup La. This they succeeded in doing. It took them four days to cut their way through the great ice-fall, a fine mountaineering achievement.

Meanwhile, Evans, Gregory and I explored a complicated knot of country lying between the Pangbuk, the Langmochi, the Menlung, and the upper Rolwaling valley systems. At first we tried to reach it by crossing a series of passes from the north, and then by an approach up the Langmochi from the

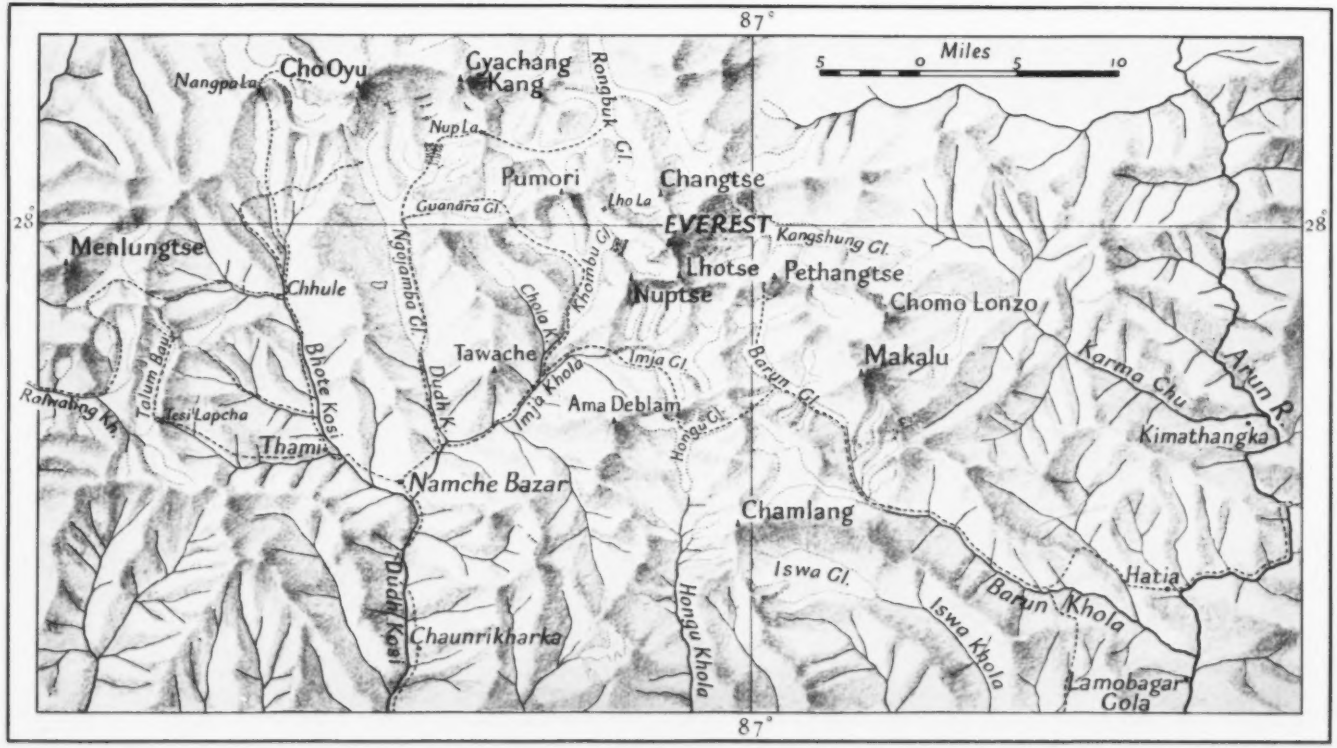
east. In both these attempts we failed to find a way through, which underlined the remarkable good fortune of Ward and myself in our discovery of the Menlung La the previous autumn. Finally we crossed the Tesi Lapcha and made our way northward up a glacier known as the Talam Bau to a curious ice plateau which turned out to be the hub of the area. While we were engaged on this work we climbed two peaks, one of 21,000 feet and the other of 21,600 feet. In all, the expedition succeeded in climbing eleven peaks of altitudes ranging from 20,000 feet to 22,600 feet, as well as a number of smaller mountains.

When we returned to Namche at the end of May, I decided to undertake, with Evans, Hillary and Lowe a journey to the east to explore the main range between Everest and Makalu, and from there to descend the unexplored valley of the Barun Kola to the Arun River. This was a project on which Hillary and I had set our hearts since our discovery, in the autumn of 1951, of two passes leading from the head of the Imja Kola to the Hongu, and thence across to the upper basin of the Barun. The chief uncertainty about the scheme lay in the descent of the Barun valley. The distance from the point at which we would reach it to its junction with the Arun is 25 miles. In that distance it penetrates an enormous mountain massif and its floor drops from 17,000 feet to 4000 feet above sea-level. The resulting gorge was likely to be formidable. My experience of Himalayan gorges had taught me that if they, or their upper valleys, are uninhabited and thus unfurnished with tracks, the work involved in forcing a way through them may be so laborious as to restrict progress to less than a mile a day. Thus the traverse of a gorge of such length might, if it proved to be trackless, take many weeks; to attempt such an undertaking during the height of the monsoon would be inviting serious trouble.

To save time in the early stages of the journey and to learn more about the great valley, I sent Evans and two Sherpas ahead on June 1 to extend our reconnaissance and to investigate the head of the Barun gorge. I had to remain in the vicinity of Namcha for some days to wind up the expedition and to await the return of Hillary and Lowe from the Nup La. I met them at Pangbochi on June 8, and we set out almost immediately up the Imja, taking six Sherpas with us. The crossing of the pass into the Hongu was a great deal easier than it had been the previous autumn, but we were carrying three weeks' food supplies, and we had a great deal of trouble getting our heavy baggage over.

We met Evans at a rendezvous by the big lake in the Hongu basin. He had very satisfactory news. He had crossed to the Barun, and had travelled down the glacier. He had found evidence that the valley below was used as a grazing ground for yaks. This relieved us of all anxiety regarding the descent of the gorge, for it meant that we would find tracks connecting the upper valley with the permanent habitations in the Arun valley, which would surely enable us to reach them within a week or so from the foot of Makalu. We would thus have plenty of time to spend on the exploration of the Barun Glacier and the main range.

Heavily laden with supplies we crossed the "Barun Col," about 20,000 feet, and camped on the glacier plateau beyond. From here on successive


87°
Miles
5 0 5 10
Cho Oyu
Gyachang Kang
Nangpa La
Nup La
Rongbuk Gl.
Pumori
Changtse
Lho La
EVEREST
Kangshung Gl.
28°
Menlungtse
Chhule
Ngojamba Gl.
Khoimbu Gl.
Nuptse
Lhotse
Pethangtse
Chomo Lonzo
Makalu
Tawache
Imja Gl.
Barun Gl.
Karma Chu
Arun R.
Kimathangka
Rolwaling Kh.
Talum Bau
Tesi Lapcha
Bhote Kosi
Dudh K.
Imja Khola
Ama Deblam
Hongu Gl.
Thami
Namche Bazar
Chamlang
Iswa Gl.
Hatia
Barun Khola
Iswa Khola
Dudh Kosi
Chaunrikharka
Hongu Khola
Lamobagar Gola
87°

days we climbed two peaks of 22,550 feet and 21,800 feet. The views from these were exceptionally interesting and impressive; for we were now in an unexplored region surrounded by some of the greatest mountains on earth. An entirely new aspect of the Everest massif filled our north-western horizon, while eastwards our gaze lifted to the lofty spire of Makalu (27,750 feet) across the cloud-filled chasm of the Barun.

We saw that the ice plateau drained to the south-east into a glacier which flowed through a remarkable defile east of Chamlang (24,012 feet). I was very tempted to try to penetrate this glacier gorge, which was unlike anything I had seen before, but it might have taken a long time and our main interest lay farther north. Later we found that the glacier entered and flowed some miles down the Barun valley, a long way below the snout of the Barun glacier. It must be at least equal in volume to the latter.

On June 15, while Lowe and I were escorting the Sherpas across a subsidiary pass and down to the Barun glacier, Hillary and Evans climbed a third peak of 21,400 feet. We camped on the Barun glacier immediately below the huge western face of Makalu which, almost devoid of snow, looked from here like a vast stone quarry. The next day we travelled 5 miles up the Barun glacier and on June 17 we succeeded in reaching a saddle on the crest of the main watershed overlooking the Kangshung glacier, which flows from the eastern face of Everest. In this way we connected up with the explorations of Howard Bury's reconnaissance expedition in 1921.

We camped at the foot of Pethangtse (22,080 feet) and we hoped to make the ascent of this beautiful peak, which is such a well-known feature seen from the north across the head of the Kangshung glacier. We found a good route up it, but before we could make the attempt the weather broke badly. Nearly a foot of snow fell in a few hours and by morning avalanches were falling from all steep slopes. The monsoon had broken in earnest.

We now entered a new and enchanting world. The climax to all the vivid experiences of mountain exploration comes with the descent, from the labyrinth of glaciers and ranges crossed, into the new country beyond. The tempo of life is quickened, and sensibility is supremely receptive. Life was so full that the next two weeks, as we made our way through rapidly changing environment of climate and scene, seemed to occupy more time than the whole of the rest of the expedition.

Some miles below the glacier we emerged from a gloomy defile into open country of great beauty. An eastward bend in the valley below, which was blocked by the intrusion of the "plateau glacier," and the defile above gave us the impression that we were in a wide basin, completely encircled by snow mountains and dominated by the south face of Makalu, a vast structure of ice-falls and hanging glaciers. Many square miles of rich pastureland, very green after the recent rains, formed its floor. Here we found a great variecy of familiar alpine flowers which had been notably absent from the Khombu valleys, owing, I believe, to the lack there of calcareous rocks.

Our first contact with the inhabitants of this side of the range was typical. At the farther end of the "basin" we came to a sharp drop in the valley. Half a mile below us we saw two men engaged in building a hut. The Sherpas were behind us, and we sat down to wait for them, intending to creep up on

Plateau glacier flowing down into the middle Barun

the men together and get close enough to explain who we were before they had time to become alarmed. But the Sherpas, as soon as they saw them, rushed down the hill uttering cat-calls and piercing whistles. The men fled down the valley, leaping from boulder to boulder like a couple of deer. We tried to head them off, but they soon disappeared, moving at an astonishing speed. Their panic was very natural, seeing a crowd of strange creatures rushing down upon them from a vast range of mountains that everyone knew to be impassable. I was very angry with the Sherpas for their tactless handling of the situation, which I was afraid might spread terror far down the valley.

However, the men must have hidden themselves in a side nullah, for when eventually we reached the pastures below the "plateau glacier" we found encampments of shepherds quite undisturbed by reports of monsters descending from the snows, and we quickly established diplomatic relations, which were so essential for our welfare. We found that the people were Buddhists, but totally different racially from the Sherpas. We engaged a man to show us the way down the gorge and along the tiny forest tracks connecting the pastures of the middle Barun with the villages of the Arun valley, still several days' march away.

Below the end of the "plateau glacier" the valley fell steeply, and we soon found ourselves in dense forest. We were now entering a zone of far greater rainfall than that of Solu Khombu, and though giant rhododendron and fir predominated at about 12,000 feet the vegetation as a whole was totally different. In form the valley resembled a Norwegian fjord: it was broad and flanked by gigantic rock precipices decorated by innumerable waterfalls; but the bottom was wide and gently curved, showing that for many miles below the present level of ice glacier action had been at work so recently that the river had not had time to cut into the floor. It was not until we had descended to 9000 feet that the valley began to develop into a true Himalayan gorge.

At this point we separated from Evans, who was keen to extend the journey eastwards to the Lumba Sumba Himal, and across that range to Taplejung, and thence to Darjeeling. Unfortunately, none of the other three of us was able to spare the time to accompany him on this interesting journey. Hillary and Lowe had to catch a boat on July 18; while I was under some obligation to return as soon as possible to assist with the preparations for the 1953 Everest Expedition. The best two Sherpas went with Evans.

We now turned southwards, climbed steeply from the dense, tropical forest of the Barun gorge and crossed into the head of the Kasuwa Kola. Although the intervening pass was only about 13,000 feet there was still much winter snow lying on the more protected slopes, evidence that the winter snowfall is here much greater than in Khombu. The rhododendron bushes were in bloom, white and crimson; the grassy slopes below the rocky hills and the meadows bordering a score of lakes and tarns were carpeted with primulas of many colours and with deep drifts of yellow flowers.

We had now reached the outer edge of the high mountain massif and from the pass we looked through shifting banks of cloud, out across the foothills far below. During most of this part of the journey we experienced frequent heavy rainstorms, but the periods between were fine and sunny. Three days later, after having some difficulty in crossing the flooded Kasuwa Kola, we

reached the banks of the Arun, which we crossed by a rope bridge near the village of Num. The Sherpas were now lightly laden and, starting at 4.30 each morning, we made a rapid march down the Arun. At Legua Ghat we joined the route by which we travelled up in 1951. From there we crossed the hills to Dharan and Jogbani.

DISCUSSION

Evening Meeting, 22 December 1952

Before the paper the PRESIDENT (Mr. J. M. WORDIE) said: It is my pleasure to introduce Mr. Eric Shipton, the best known of all British climbers. To give a list of his achievements is to give an account of British climbing during the last twenty years. It was Mr. Shipton's privilege to introduce Tilman to mountaineering in East Africa, and together they climbed Kilimanjaro and Mount Kenya. This was the beginning of a very warm friendship between these two outstanding mountaineers.

Shipton's first experience of Everest was in 1933. As an interlude he climbed Nanda Devi in 1934, then he conducted a reconnaissance of Everest in 1935 and again climbed these in 1936 and in 1938. In 1937 he visited the Shaksgam valley. For those travels and explorations he was awarded the Patron's Gold Medal in 1938.

Mr. Shipton then read his paper

The PRESIDENT: Mr. Shipton has mentioned Dr. Pugh, whom I now ask to give an account of the physiological problems connected with the climbing of Mount Everest.

Dr. PUGH: There are a number of physiological questions connected with the climbing of Mount Everest, and as it is not possible for me to enter into all of them now, I will speak only of the temperature and the oxygen problems.

From the records of the temperature lapse rate that we took all the way up to Everest one would expect the temperature at the top to be −40° F. But judging from the accounts of previous expeditions, during the precious fortnight before the monsoon −20° is usual, and it is only that relatively warm temperature that renders the ascent of Mount Everest possible for man without some special means of conserving heat loss from the lungs. Some heat is lost in bringing inhaled air up to body temperature, and more is absorbed in saturating the inspired air with moisture. At 28,000 feet, 75 per cent. of the heat produced by the human body at any given rate of exercise is lost via the lungs. The best Arctic suit available is not sufficiently effective to prevent the body cooling down when there is such an enormous heat-loss via the lungs. When the body temperature has fallen by 40° F. movement becomes increasingly difficult; when the temperature has fallen about a further 3° people go into a coma. That might well happen on Everest without oxygen at this time of year. So that even if the climbers reach the summit they might sit down on their way back from the summit and just die of cold.

At −20° the position is different because the heat lost from the body is so much easier to retain by good clothing; moreover, on a fine still day at high altitudes there is a considerable amount of heat from the sun. In fact the sun's heat at high altitudes may well be equivalent to that produced by a man at rest. I think this factor has accounted for the experience of climbers on Everest in the past who, though at a very high altitude on a still day, have not felt very cold—at least not all the time. Another point is that it is impossible to climb

Everest in a high wind. Normally the wind on Everest blows at 100 miles an hour. It seems that it is only at certain periods of the year, before and after the monsoon, that these high winds are not present on Everest. Thus a successful ascent of the mountain depends on getting a still day.

Now as to the oxygen problem. A climber requires exactly the same volume of oxygen per minute at sea-level as at 27,000 feet. We were able to confirm that by doing standard work at 20,000 feet and comparing the results with exactly the same work at low altitudes. Since the density of the air decreases with altitude, in order to get a given volume of oxygen it is necessary to breathe decreasing amounts of air. Imagine the climbers walking slowly along the summit of Everest. In so doing they will require 1 litre of oxygen per minute. In actual fact it might be found that at 28,000 feet a steady level of activity is no longer possible. If I remember rightly, Norton said his object was to do 20 paces without stopping, but that in fact he never achieved more than 13 paces without resting and panting. In other words, the situation is much like that of runners doing a succession of 100-yard sprints. I do not deny the possibility of climbers able to walk at 29,000 feet without oxygen. What I think would defeat them would be the time factor, because it is not possible to continue doing 100-yard sprints indefinitely for six hours at a stretch. The body would not stand that type of activity at high altitude. My view is that the day is not long enough to allow climbers to go from the final camp at 1500 feet below the summit and to come down again the same day, without oxygen. If they were overtaken by night or bad weather without their tent they would certainly die of cold.

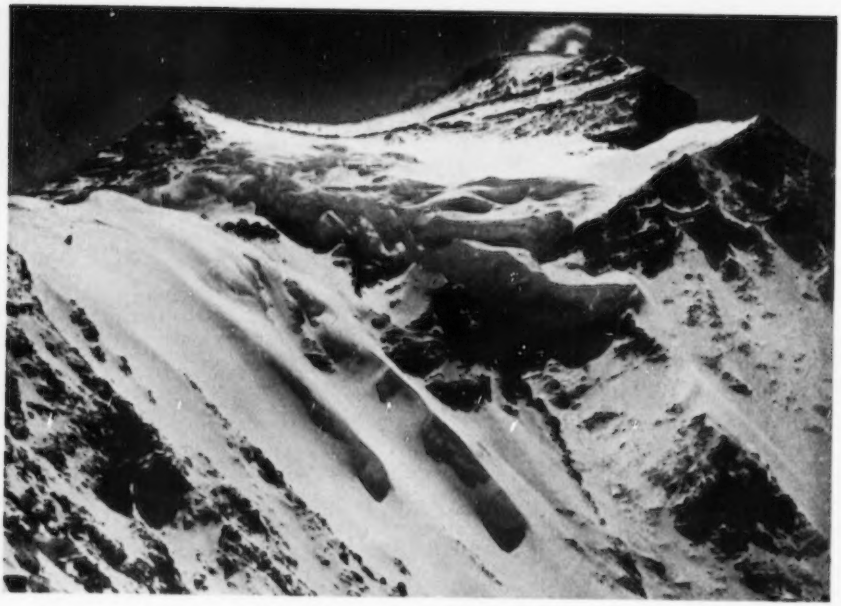
For these reasons climbers ought to try to make use of all the resources which are available and take oxygen when climbing at high altitudes. But the point is that even with oxygen Everest is an extremely difficult mountain to tackle. If you go into a decompression chamber and work on a stationary bicycle, even if the pressure to which you are exposed corresponds to 30,000 feet, by dint of breathing pure oxygen it is possible to work just as though the atmosphere was at sea-level pressure. That is to say, by giving oxygen to an unacclimatized man at 30,000 feet it is possible to get a sea-level physical performance. The curious thing is that those who are acclimatized to high altitudes without oxygen, when given oxygen do not give anything like a sea-level performance. That is unfortunate. It has been suspected from the experience of parties on Everest, among whom certain individuals have used oxygen. Finch used it in 1922 and he claimed great benefit from it. He used it all the way up from 23,000 to 27,000 feet and he claimed that he climbed more quickly than the porters. He used $2^{1}/_{4}$ litres of oxygen a minute. Odell in 1924 said he derived no benefit at all from using oxygen. He used only 1 litre of oxygen per minute. That is not enough, which is obvious when one considers that the breathing rate is 100 litres per minute. If only 1 litre is added it makes only 1 per cent. difference.

Further experiments showed the effect of supplementary oxygen at 20,000 feet. The measure of the performance was the time ta'ten to walk up 350 feet. With supplementary oxygen supplied at 10 litres per minute only a 10 per cent. improvement in time was gained. At 4 litres per minute there was less improvement; in fact, virtually none at all. This was caused by the weight of the apparatus to which Mr. Shipton has already referred. Men carrying the apparatus and not getting any oxygen, took 35 per cent. to 40 per cent. longer to climb the 350-foot hill. It is difficult to supply men with enough oxygen to get to the top of the mountain without having to carry an apparatus which is too heavy. That is the problem we are now trying to solve.

Ferryman on the Sun Kosi

Path in Dudh Kosi below Namche

Makalu from 22,500 feet. Hillary in foreground



Cho Oyu from 21,000 foot camp

Another important point noted was that when oxygen was given the breathing rate was suddenly reduced, and the users of oxygen have found that the benefit has been due to that reduction in the effort of breathing. While their physical performance is not enormously improved, their conscious sense of effort is greatly relieved by reduction in their ventilation rate. This is an important factor.

There are three possible ways of taking oxygen: one is by the open-circuit system, breathing oxygen through a cylinder at 2, 3 or 4 litres a minute, and breathing it out to the air, when nine-tenths of the oxygen is lost. The second is to have a closed circuit in which the air breathed goes round and round, and oxygen is added at the rate at which it is used, the carbon-dioxide in the expired air being absorbed with soda lime. The advantage is that the climber gets pure oxygen and his equivalent altitude is at sea-level. There is the same oxygen in the atmosphere he breathes as if he were at sea-level. The important second advantage of this system is that no heat is lost in warming and saturating the air with moisture. So the closed circuit on both those counts has great advantages. Unfortunately, it is difficult to make and the mask has to fit perfectly, otherwise the apparatus fills with nitrogen and one cannot continue to use it. Equally, it is difficult to make the air pass through the soda lime, so that the carbon-dioxide is completely absorbed, and at the same time prevent back-pressure building up. Even a small back-pressure becomes intolerable when climbing. When a closed circuit was tried by Lloyd he found it unusable, probably because of the back-pressure. Those are the main points in regard to the closed circuit: the difficulty of making the mask fit perfectly and of designing a set which will not give any back-pressure. Also it is even more difficult to make such apparatus as light as an open-circuit apparatus.

The third system depends on the chemical evaluation of oxygen. The Swiss in the spring of 1952 tried an apparatus weighing only 3 or 4 lb., but I am afraid they under-estimated the quantity of oxygen they needed, and their set had all the faults I have mentioned as being inherent in the closed-circuit apparatus. They had a mouthpiece which leaked and their apparatus became unusable from that point of view. Also it did not supply nearly enough oxygen to allow of the necessary performance. We are trying to develop an improved apparatus on these lines, but I am not sure that it will work. We are therefore putting our faith in the old-fashioned open-circuit system because we know that that will work. The unfortunate part is that because nine-tenths of the oxygen is wasted, it is necessary to take with us a large number of oxygen cylinders. It is doubtful whether it will be possible to take enough up to the South Col to supply the climbers with sufficient oxygen.

I would myself like to see the climbers going up all the way from 15,000 or 18,000 feet breathing oxygen and sleeping with the apparatus on. That ought to solve the question whether acclimatized climbers do or do not derive much benefit from oxygen. If one is acclimatized to 25,000 feet and then breathes oxygen, the improvement in performance may still be insufficient to get one to the summit of Everest in a day. I hope that on the forthcoming expedition there will be during the acclimatization period an opportunity of doing experimental work and that it will be possible to get some direct evidence on the points I have mentioned. Perhaps we shall be able to breathe oxygen from relatively low altitudes and get a really fine effect instead of a relatively small one.

The PRESIDENT: We all thank Dr. Pugh for the way in which he has explained these problems of a physiological nature. He will be going back on the expedition this coming spring. I ask you now to join together in thanking Mr. Shipton and Dr. Pugh for the admirable information they have given us to-night.

THE LAND OF SINAI

G. W. MURRAY

BEFORE DESCRIBING the land, I want first to say a word or two about the people of Sinai. Not all are Bedouins. Here and there, in the palm groves of Qatia and Feiran, are the descendants of earlier invaders who have lost face by taking to cultivation. In the region round the turquoise mines are miners who are descended, perhaps, from those who worked at Sarabit and Maghara in ancient Egyptian days. At Nakhl, there used to be a colony of Moors, left as garrison by the old-time Turkish Government. Another garrison, of Bosnians, was left at El-'Arish and the present townsfolk are largely their offspring. The Gebeliya, or gardeners of the Greek Monastery of St. Catharine, are also Bosnian in origin, presented as slaves to the monks by the Emperor Justinian. They have still an European cast of countenance but, in dress and habits, ape the Arabs around them.

So far I have only mentioned the working classes, despised as such by the true Bedouins who never work. They leave that to their wives. Of them, I wrote once: "They are all conservative to a degree, incurably greedy, incurably generous, incurably romantic and incurably lazy. Their contempt for the accumulation of worldly possessions and their chivalry are the best points, their love of litigation the most tiresome." [1] Of these, the Arabs of northern Sinai are mostly offshoots from the Beni 'Atiya of Arabia. More recent immigrants are the Haweitat from Trans-Jordan. These are still coming in.

In southern Sinai, the original inhabitants are said to have been the Beni Suleiman, the Hamada and the Beni Wasil. Not long after the Arab conquest of Egypt, the Sawalha and the 'Aleiqat were living in Sharqiya, the eastern province of Egypt, the "Goshen" of the Bible, from which they regularly raided south Sinai to carry off the dates of Feiran or to graze their camels wherever there had been rain. One year, these two tribes migrated *en masse* into the Peninsula where they succeeded in conquering the Beni Suleiman and the rest, some of whom fled while others were absorbed into the conquerors. The parallel with the children of Israel and the way they dealt with the Amalekites is striking.

But, instead of waiting forty years and gathering strength to become a nation, the two tribes quarrelled and victory was inclining towards the Sawalha when there arrived from Arabia seven tents of the Muzeina, the remnant of a noble tribe, flying from the results of a blood feud. These asked permission of the Sawalha to share their grazing. But this the Sawalha refused, unless the Muzeina paid them tribute—a submission which is held degrading among the Bedouin. So the proud Muzeina went off to join the 'Aleiqat and both tribes together overcame the Sawalha in a battle fought in the Watia Pass on the main road to the Monastery. A sensible compromise then took place by which the three tribes divided the peninsula among them.

To the map reader and the air passenger Sinai seems no more than a bridge

[1] 'Sons of Ishmael,' 243.

MEDITERRANEAN SEA
Gaza
Port Sa'id
Kathib el-Qais
Sabkhet el-Bardawil
Rafa
Bay of Pelusium
El-Arish
El-Tina
Romani
Qatia
Bir Lahfan
El-'Auja
El-Qantara
Abu Aweigila
El-Buafa
G. Maghara
Isma'iliya
G. Halal
Quseima
Ain el-Gedeirat
Bir Hasana
Bitter Lakes
G. Yelleq
W. El-'Arish
W. Jerafi
Mitla Pass
Suez
El-Kubri
Port Taufiq
Nakhl
El-Kuntilla
Darb el-Hagg
'Ain Sudr
El-Themed
Ras el-Naqb
El-'Aqaba
S I N A I
Tih escarpment
Gulf of Suez
Gulf of 'Aqaba
Abu Zenima
Sarabit el-Khadim
Nuweiba
Paran
Feiran Oasis
W. Feiran
W. el-Sheikh
St. Catharine
W. Laghita
G. Serbal
G. Katharina
G. Musa
W. Nasb
Dahab
G. Umm Shomar
G. Rimhan
W. Gharab
Moiyet Luliya
El-Tor
G. el-Thabt
G. Yithmid
G. Sabbagh
Sharm
Ras Muhammad
RED SEA
20 0 Miles 20 40
33°
34°
35°
31°
30°
29°
28°

joining the continents; to some 10,000 Arabs it is their home; to the Jew and the historian it is the Land of the Wanderings of Israel and the Mount whereon Jehovah spoke with Moses. To some 100,000 passengers a year it is the dull east bank of the Suez Canal; to 30,000 pilgrims it is the quarantine enclosure at El-Tor from where they gaze across the gravel flat of the Qa' to the glorious mountain chain beyond. To the Shell Company and the Socony Vacuum it is the source of a million tons of oil a year.

Northern Sinai is just a limestone plateau sloping gently down to salt marshes caused by the sinking of the shore. In the west, this sinking is locally compensated for by the eastward drift of silt brought down by the Nile which is slowly filling up the Bay of Tina [1]; so much so that the site of the ancient Pelusium, once a port at the mouth of a branch of the Nile, is now more than 2 miles inland.

A dune belt stretches for 100 miles from the Bitter Lakes to Rafa, with its greatest thickness south of Romani where it is pitted with hundreds of hollows eaten out by the wind. Each of these hollows is dotted with palm trees; and, at 4 or 5 feet down, one reaches the water table where a foot or so of fresh water floats on the salt. This water is the accumulation of several winters' rain and must not be disturbed lest it mix with the salt. At Qatia, the centre of these oases, there is a colony of Arabs engaged in cultivation. This abundance of fresh water has greatly facilitated the march of the various invading armies that, throughout the centuries, have shuttled backwards and forwards between Salhiya in Egypt and Gaza in Palestine.

The first of these in history were the Hyksos who, about 1800 B.C., came riding out of Asia on the very first horses to enter Africa where they must have caused as great a consternation as that made by Cortes and his cavalry in Mexico. Probably the last horses to be used in war on the grand scale were those ridden in the opposite direction in 1916 by the Desert Mounted Corps under our late President Field-Marshal Lord Chetwode. I am proud to have served under him.

This route of the invaders is followed by the full-gauge railway constructed during that campaign, but unfortunately it is impassable by cars owing to soft sand, and motorists are obliged to take a tarred road, opened in 1940, from Isma'iliya on the Canal to El-'Auja in Palestine. This runs through featureless desert with views of the barren limestone ranges of Yelleq, Maghara and Hilal to Abu 'Aweigila. There it crosses the "river of Egypt," the great Wadi el-'Arish, which drains nearly all this central plateau of Sinai.[2] At this point it used to be carried over the wadi by a concrete bridge of three spans. But in 1948 an Israeli raiding force surprised the Egyptian bridge guard and made a most scientific demolition of the piers, thereby severing road communication between El-'Arish and Egypt. At the same time their armoured cars raided the outposts at Qusaima and Bir Hasana. The raiding

[1] The mud brought down by the Nile is carried eastward at a rapid rate, and a recent revision of the Egyptian 1/25,000 series of maps shows that the promontory at the mouth of the Damietta branch has lost about 700 metres of its length during the last twenty-five years. Most of this mud has gone to make new land at Port Sa'id, where it is caught by the breakwater at the Canal entrance.

[2] The rain that falls on the hills between El-Themed and Ras el-Naqb is drained by the Wadi Jerafi into the Dead Sea.

force, preceded by a Sherman tank, advanced down the branch road towards El-'Arish till it came under artillery fire near Bir Lahfan. Here the Sherman tank was blown into four pieces by a direct hit from a 25-pounder. Its remains still lie on either side of the road near Kilo.13. El-'Arish was saved but the Egyptian battery commander did not live to be rewarded for his accurate shooting, for he was killed in action later the same day.

Now that the bridge is gone, this branch road to El-'Arish is cut off from Egypt once or twice every winter by sudden spates of the wadi. But an alternative road on the west bank was under construction last year and may be finished by now. Besides this road from Isma'iliya, it is barely possible to travel all the way from Port Sa'id to El-'Arish along the shore. I have not done this, but I understand that most of the journey has to be made on the sand wetted by the waves. After passing Kathib el-Qals where Pompey the Great was murdered there is a gap in the sand bar between the sea and the lagoon of Bardawil.

Without some previous arrangement as to ferrying, there is likely to be delay. The route was, however, used by the Roman army under Titus on its way to the siege of Jerusalem and Major Jarvis has suggested that the children of Israel may have taken this way for their Exodus. Certainly the Ecregma, as Josephus calls the gap, might well have been the scene of the discomfiture of the pursuing Egyptian chariotry. Yet, with pursuers in his rear and the possibility of a hold-up at the gap, the situation savours rather too much of a trap to deceive such a leader as I take Moses to have been. Nor, as I am about to suggest, do I think that, on leaving Egypt, Palestine was his immediate objective.

El-'Arish, the capital of Sinai, had a pre-war population of about 4000, but this figure has been more than doubled by the influx of refugees and the presence of an Egyptian garrison. The old fort, which resisted Napoleon for a few days in 1798, was destroyed in 1916 by a combined air and naval bombardment and a hospital now nestles in its ruins.

Beyond El-'Arish the road and railway run together inside the dune belt till one comes to Rafa in a great plain, green after rain with grass. The empty plain seemed dull, but it was far from dull in 217 B.C. when Ptolemy IV of Egypt with 73 African elephants encountered Antiochus the Great of Syria with 102 Indian elephants. Ptolemy won, but the credit was due to his infantry phalanx and not to his elephants which, when they felt the arrows, stampeded back through the ranks of their own army. They were as great a disappointment as our tanks were before Gaza in 1917.

At Rafa we entered the strip of Palestine held by the Egyptian Army. To me, Gaza seemed to have been greatly improved during the last forty years, but the wretched camps of the Arab refugees were an appalling sight. There were said to be 100,000 of them in this strip, 20 miles long by 5 miles wide, in addition to its ordinary population. Many of the children had face-sores, a symptom of malnutrition. The tents that sheltered them were in rags.

Miss Freya Stark has said very wisely. "It is good to know the truth and to speak the truth. But it is better to know the truth and to speak about palm trees." Let us speak about palm trees. El-'Arish is separated from the sea by magnificent groves of date palms, but these disappear at the frontier and

Gaza has none of them. Again, in Sinai as in Arabia, the date palm is found wild wherever there is a spring; stunted growths which are said to bear no fruit yet seem to spread without human interference. In the eastern desert of Egypt, on the other hand, date palms are so rare that they appear to be confined to gardens planted and kept up by men. The tree does not seem to be indigenous to Africa.

To return to El-'Arish. South of the town extends the delta of the great wadi which, for 30 miles back from the coast, consists of terraces of a fine dust, excavated up country by the wind but deposited here by water. The water table is only 30–100 feet down and, here and there, is exploited by private enterprise. An opportunity is thus provided for settling some of the refugees, but up to the present the policy of the Egyptian Government has been to reserve the area for its own rapidly increasing population.

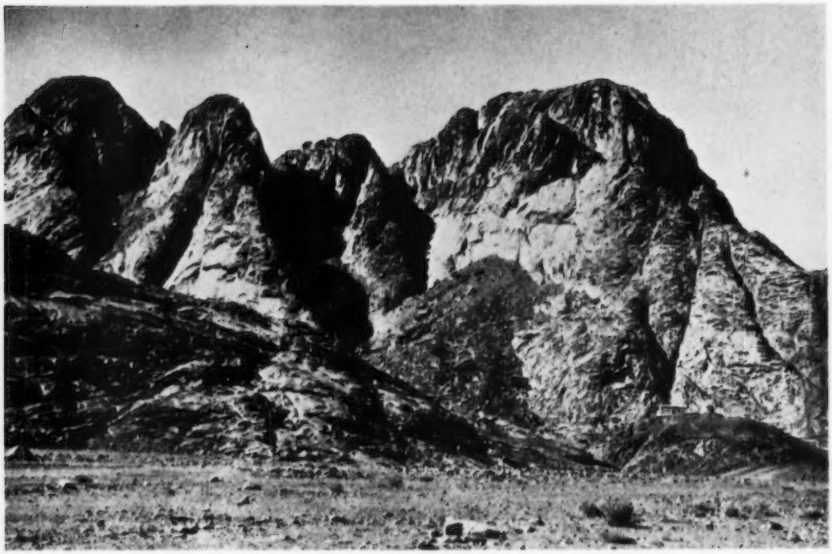
A project to irrigate this flood-plain by canals fed from dams has been initiated and, in 1947, a pilot dam was built at el-Ruafa, just south of the Abu 'Aweigila bridge. This was filled within a fortnight by a sudden spate which dropped 2 feet of silt in the reservoir. When we saw it in 1951, the silt had accumulated to a level above the outflow pipes that were to have led the water into canals which have yet to be dug. The dam had been made useless.

The unusually heavy load of silt which the Wadi el-'Arish has to carry is due to the intense aerial denudation of the very soft Cretaceous marls and clays which one sees everywhere exposed in the central plain of Sinai. Cloudbursts do not happen sufficiently often to remove all the dust and, in the upper reaches of the wadi and its tributaries, the fairway for cars is often choked by stream-lined hummocks of clay packed closely together. In the gorge of El-Dha'iqa where the wadi cuts through Gebel Hilal, a shaft sunk to find firm rock for the foundations of a larger dam than the el-Ruafa one failed to reach rock at 26 metres down. Such an accumulation of nearly 100 feet of silt in a narrow gorge proves the continuation of arid conditions in North Sinai over a long period; for any regular rainfall would have scoured the gorge down to bed rock. A third dam, a very much smaller affair below 'Ain el-Gederiat near Qusaima, which stored water for the only patch of cultivation in north Sinai away from the coast, is now filled with silt to the brim. As in other deserts, a dam across a Sinai wadi has a very short life indeed.

Besides the Isma'iliya–El-'Auja road, there is an earlier untarred road to Jerusalem, almost fallen into disuse, which leaves Egypt at El-Kubri, the ferry north of Suez, traverses the Raha Hills by the Mitla Pass, joins the Darb el-Hagg, the pilgrim road to Mecca, only to leave it again at the exit from the hills and strikes north-east to Bir Hasana, where there is a rest-house and some wells sunk by the Turks in 1915. The water is plentiful but very brackish.

Beyond Bir Hasana, the road runs through a field of baby barchans, the moving crescentic dunes which are only found where there is a constant wind from one direction, and past the foot of Gebel Hilal to the frontier post at Qusaima. There one can just distinguish the embankments and cuttings of the projected Turkish railway for the invasion of Egypt. The rails themselves never crossed the border. Like all other routes to Palestine from Egypt, this road is now closed.

1. Monastery of St. Catharine



2. Ras Safsafa

3. Gebel Umm Shomar

Returning to the Darb el-Hagg, which we left at the exit from the Raha hills, and continuing eastwards, one arrives at Qal'et el-Nakhl, the "Fort of the Palm." Here, early one morning in 1906, my old friend Wilfrid Jennings Bramly was awakened with the alarm of a Turkish invasion. Certainly, there was an army "terrible with banners" advancing on Nakhl from the great plain to the east. But this was no Turkish horde: it was the very last of the pilgrim caravans to return from Mecca to Egypt by land. All pilgrims have now to go and return by sea, performing quarantine at Tor.

Before the First World War, Nakhl was the seat of the Governorate and the centre of the Sinai telephone system. But in 1914, when the Turks seized El-'Arish, Nakhl Fort was blown up and the inhabitants were evacuated to the Canal Zone. Later, most of them migrated to El-'Arish and Nakhl now consists of a rest-house, a small police barrack, two deep wells and the ruin of the old fort.

From Nakhl, the pilgrim road runs on to Ras el-Naqb, a police post at the top of the abrupt descent of 3000 feet through Palestinian territory to the sea at El-'Aqaba. The gradient is here so steep that, in the early days of motoring, more than one car which had made the descent was unable to return and was compelled to make an immense detour via Ma'an and Jerusalem before it could return to Egypt. South of the Darb el-Hagg, the limestone plateau rises to 5000 feet at its southern edge before dropping away in steep cliffs on either side of a great promontory pointed at Mount Sinai.

On May Day 1929, my wife and I embarked in the Khedivial mail steamer *Talodi* at Port Taufiq and spent the afternoon watching pilgrims embark for Jidda. Soon the decks became so crowded that we could only pass along them by holding our terriers in front of us and shouting:

"Make way for the unclean!"

The would-be Haggies laughed and obeyed. As the ship left the roads, the muezzins in her bows called to prayer and all noise was hushed. Under a myriad stars the *Talodi* slid forward over a still sea.

At dawn we landed at El-Tor and spent a day in preparation for our journey. The view from Tor to the east may be pictured by imagining Vevey or Montreux on a hot day with the Lake of Geneva dried up and the Alps beyond devoid of snow or trees. Seven hours of plodding across the waste with a camel caravan brought us to the mouth of Wadi Isla, where we camped among warm red hills beside green reeds and trickling water.

Higher up, the wadi contracted till the waving reeds met in an arch overhead as the camels pushed their way through the vegetation. Presently, the canyon was only a few feet wide and our beasts had to stumble up a natural staircase of smooth granite, while beneath their feet the former river Isla, shrunk in its old age to a mere trickle, gurgled down unregarded. A vivid effort of the imagination was needed to identify this with the thundering series of cataracts which had once eaten out this mighty ravine.

From Isla we turned away to ascend El-Thabt, 8035 feet, the third mountain of Sinai. From its summit the view could hardly be bettered. The dark-blue gulfs of Suez and 'Aqaba met and merged in the broad Red Sea, the highway to the Orient. Beyond, on either side, rose the misty mountains of Egypt and Midian. Before us and below us opened out a great cirque,

hemmed in by three unclimbed peaks of the watershed and Gebel Sabbagh, the most southerly of the Sinai high mountains. Thirst soon drove us down some very steep and easy rocks into the cirque, where our camels were waiting at Moiyet Luliya, "Pearl's Spring."

To "Pearl's Spring" we returned next morning, intent upon the conquest of the virgin Gebel Yithmid, which we achieved by noon. We moved again down through dry hot valleys to the shore of that Arabian fiord, on whose waters ships float only in war-time, the Gulf of 'Aqaba. On the second evening we camped in the abandoned headquarters of a copper mine in Wadi Samra, where lizards chirped in the roof and we enjoyed a view of the bright blue sea. Though it was 8 p.m. the thermometer registered 92°, but we could not resist the temptation of kindling an immense bonfire of old boxes which lit up our surroundings in a melodramatic way and may have puzzled the brigands on the far side of the gulf. From the mine we gathered beautiful museum specimens of the ore *chrysocolla*.

Next morning we were down on the shore. To the north, the cliffs approached the water's edge so closely that our beasts were forced to crunch the gravel of the beach itself with their feet. To meet us came two parties of stately camels, which had been to water themselves at the wells in Wadi Ghurabi, two hours farther north. No man attended them. At the mouth of Ghurabi we camped and sent our beasts up to water.

My wife was soon down on the reef to bathe and as soon up again. She had seen a sea-snake, 3 feet long, yellow with red bands, swimming rapidly after small fish. Biologists say this must have been a Moray eel; as sea-snakes do not occur in the Red Sea. If eels can swim with their head out of water, they may be right. Later, we caught eight crayfish clinging to each other's backs in the corner of a pool. One of our police escort went in and handed them out. Two more which tried to escape over the reef were intercepted by my terrier Tiglath on their way to the sea. In the morning the tide was in and our camels were obliged to splash through the sea round two headlands which, at low water, they could have passed dryshod. Early that afternoon we camped by the palms at Ginai. Here the motor track from Sharm which had made a great detour inland came down to the sea again.

Next day an hour's pleasant march brought us to Dahab, the capital of the Muzeina. This consisted of a safe little anchorage, three large palm groves—and no inhabitants. Dahab is only inhabited during the date harvest. The name means "gold," but there is no gold there; nor, indeed, anywhere else in Sinai. Here we turned inland for the monastery.

That evening we camped at the mouth of Wadi Zaghra, where Moringa trees in blossom grew by a great rainpool. At sunset a heavily horned ibex stared down at our tent from a cliff. I tried a long shot at him but missed. All next morning we marched up the long straight Wadi Zaghra where we met a Muzeini who alleged that his tribe were sacrificing a camel that day at the tomb of Nabi Salih. Consequently our caravan made a forced march of nine hours instead of their usual six and arrived at the tomb to find nobody there and no hospitality. However at sunset our riding camels were led ritually seven times round the tomb of the prophet.

After the heat of the Gulf of 'Aqaba, the night seemed cold and the dawn

temperature stood at 54°. My wife and the terriers shivered. Very soon we set out on the last leg of our pilgrimage up the 10-mile long vista of Wadi el-Sheikh, bright with sunlight and barred with shadows of the peaks to the east. Presently we turned to the right, bought some eggs from the Gebeliya, the gardeners of the monastery, and pitched our tents below the precipices of Ras Safsafa, the northern promontory of Gebel Musa, the traditional "Hill of the Law."

Though the exact site of the Law Giving has been lost beyond hope of recovery, yet the words of Scripture that "a brook ran down from the Mount"[1] and "there were thunders and lightnings and a thick cloud upon the Mount"[2] limit the choice, in these waterless countries, to some very high mountain indeed. Umm Shomar is inaccessible to a multitude, Serbal has no plain at its base; but, here, at Ras Safsafa, there is nothing discordant, nothing to be explained away. Somewhere hereabouts, among these bare red solemn hills, it is easy to picture Moses the zealot becoming possessed by Jehovah, the God of the region, and going down from a high place, a frowning precipice such as can be seen on Plate 2, to be Law Giver to a Chosen People and to plant in their minds the seeds of that strong monotheism with its three branches, Judaism, Christianity and Islam which ruled the whole world yesterday and rules still a great part of it to-day. If a magnetic pole be wanted for religion, Ras Safsafa looks the part.

Half a mile up the ravine on the left lies the Greek monastery of St. Catharine, "like a frail skiff of stone between the crests of two granite breakers" as the author of the latest book on Sinai has called it.[3]

The walls of Justinian, 50 feet high and 6 feet thick at the top, enclose a great basilica, several chapels, a mosque, the well of Jethro where Moses helped the seven daughters, the Burning Bush, a library, a refectory, the cells of the monks, storehouses and various room for the reception of travellers. If you stay with the monks, it is as well to bring plenty of provisions with you, for the monks are not well supplied and theirs is a vegetarian diet.

Reception of guests follows a set pattern. You are no longer drawn up in a basket but pass through a narrow passage with a right-angled turn and a small cannon in it. Once within, we ascended to a parlour where they regaled us with quince jam and raki. Then they opened the original Byzantine wooden doors and showed us their great church of a size and of a splendour astonishing in so bleak a mountain solitude. We saw great granite columns disfigured with whitewash, swinging silver lamps and innumerable ikons. We put off our shoes in the chapel of the Burning Bush and were rewarded with a sprig of the Bush itself which grew conveniently just outside the chapel window. We admired two silver sarcophagi; one a gift from Peter the Great to the Virgin Martyr, the other covered with emeralds and rubies, sent by the Tsar Alexander II as a recompense for the Codex Sinaiticus, won from the monastery library by the Russian scholar Tischendorf. The relics of St. Catharine, found miraculously five hundred years after her martyrdom in Alexandria on the highest peak of Sinai, are housed in a heavy marble

[1] Deut. ix, 21.
[2] Exodus, xix, 16.
[3] J. Daumas, 'La peninsule du Sinai,' 138. See Plate 81.

coffer containing two gold caskets, one of which is said to hold her head, the other a hand covered with bracelets and rings. In the library you may see a photostat copy of the Codex and a copy of the firman signed by the Prophet Muhammed granting protection to the monastery. The original is said to have been carried off to Istanbul by Sultan Selim the Grim. Here I lost my heart to a 'Christian topography' of Cosmas Indicopleustes, gaily illuminated with quaint animals.[1]

Outside the walls in a garden of orange trees is a cemetery where the bodies of the monks who die rest for ten years. They are then dug up and neatly stacked in two great heaps, one of skulls, the other of bones, in a small charnel house. Archbishops alone retain their individuality, being filed in tin boxes remarkably like biscuit tins. Inside the gateway of the charnel house sits St. Stephen the Porter, the original janitor who died at his post 1400 years ago. He is quite well dressed and is said to get a new suit every 500 years.

That afternoon we made the customary ascent of Gebel Musa by the hundreds and hundreds of steps, then after a brief rest, set off for a night ascent of Katharina, 8530 feet, the highest summit of Sinai. At dawn, we shivered and saw the sun rise over Arabia while the great cone of our mountain's shadow shrank towards us from Egypt.

Yet, to true mountaineers there is only one peak of Sinai really worth the travelling to—the peerless Umm Shomar—so to the orchard at her foot and to the col above that orchard we next made our way. The four summits of our mountain watched over us as we slept and I christened them from east to west, Matthew, Mark, Luke and John. We intended to climb them all.

The two higher peaks proved easy enough, but our second day's assault on the two grim pinnacles that guard the eastern flank of Umm Shomar was only partially successful. Matthew gave us no trouble, but, though we gained the eastern summit of the double-headed Mark, we failed to pass from this to the higher western top.[2] Furiously angry, we descended and, casting envious glances at the twin virgin peaks of Rimhan,[3] the fourth summit of Sinai, we evacuated our camp on the col and set off back down Wadi el-Sheikh for the many peaked range of Serbal.

Wadi el-Sheikh, as the wadi is now called, is lined with remarkable terraces of light-coloured alluvium, resembling lake beds. There are even fossil shells of a lake species, *Limnaea*, in these beds. Yet the steep slope of the wadi, which falls 100 feet a mile, seems to preclude the former existence of a lake or chain of lakes. The problem remains to be solved.

Just where these terraces are best developed, there is a grove of tamarisks, called Tarfet el-Gidarein. In June 1929, when passing these trees, we heard a musical clatter and found it was produced by hundreds of green beetles feeding on the sweet whitish gum exuded by the tamarisks. This gum the monks of St. Catharine give to their visitors as "manna."

In Feiran we found the Arabs all agog at the outcome of a lawsuit. One of

[1] In 1950, all the MSS. in the library were micro-filmed by an expedition sent by the University of California.

[2] A Swiss lady, Mme Escher, with two professional guides, was more successful in 1937.

[3] We climbed Rimhan in 1933.

the Tabana, outcasts who cultivate the gardens of the oasis, had been accused of pilfering from a storehouse. Denying this, he threw back the accusation on one of a true Bedouin tribe, the Wilad Sa'id. Enraged at such charge brought by a cultivator, the Wilad Sa'id had challenged the Tabani to make his words good by swearing on a white-hot spoon. The Examiner, a negro from Arabia, first licked the hot spoon himself to demonstrate that the ordeal was not harmful to the innocent. But to the guilty (?) Tabani the result had been catastrophic. His tongue was badly burnt, the sign of false swearing; and he had been adjudged to pay a fee of £5 to the Examiner and a lesser fee to the ordinary judge of the case. Those were the costs; the penalty for the theft was a fine of 10 feet of calico. Over and above all this, two white cairns had to be built to show that the honour of the Wilad Sa'id had been vindicated. The building of one of these was going on as we rode up. Everyone in Feiran, except the wretched Tabani, seemed thoroughly satisfied with the course of Sinai justice.

In the garden belonging to the monastery we met three of the fathers from St. Catharine's who were about to make a pilgrimage to the top of Serbal. All of us proceeded in company to an abandoned garden high up in the boulder-strewn Wadi 'Aleiyat.

Next morning the fathers set off for Serbal by the usual way, a tedious plod over heavy scree, while we raced them up by a more direct gully. Both parties met at an almond tree, about half an hour below the top. There, Father Joachim, now the head of the monastery, and a friend had had enough, but tall Jacobus, the Oeconomos or bursar, went on to tread the great smooth dome of the actual summit—a prophetic figure with his long grey beard and fluttering robe. Fresh leopard dung was seen all about the summit rock.

From Serbal we went on to the turquoise mines where we climbed 'Atairtir el-Dahami, a little sandstone tent on top of a granite mountain overlooking a faulted-down plain of the same sandstone 2000 feet below. Then we inspected the lonely site of Sarabit el-Khadim, the only Egyptian temple in Sinai, which stands on a high plateau; so flat and with such steep sides that it really deserves the name of "tableland." The Hathor-headed pillars of the ruin rise out of halls knee-deep in rubbish; while, outside, stand several tall twelfth dynasty (second millennium B.C.) stelae very much eaten by the wind.

For a thousand years before the children of Israel passed this spot the Egyptian miners had here worshipped a horned goddess, the Lady of Turquoise, whom they called Hathor, but whom Flinders Petrie thought might have been the Semitic Ashtaroth or an ancestress of that lady. The dedication here of conical stones, the worship in a high place on top of a mountain, the use of burnt offerings on a colossal scale are features so un-Egyptian that they practically prove that her cult was a local one Here, too, Petrie found the five famous inscriptions in an unknown alphabetic script, of which scholars can only read one word *Ba'alat*, "Goddess." As to its derivation from the hieroglyphs they cannot agree.

At Abu Zenima we went on board the Sinai Mining Company's steamer. The sons of Mudakhil, the famous old Sheikh of the 'Aleiqat, who was a witness to the murder of Professor Palmer (then Professor of Arabic at

Cambridge) in 1882, came down to see us off and Sabah thrust into my hand for remembrance his almondwood camelstick, the image of an ancient Egyptian sceptre. And with this token of the land of Sinai, we steamed away for Suez.

APPENDIX I

The Exodus

The exodus of their semi-nomadic ancestors across Sinai into Palestine appeared so marvellous to the settled children of Israel that their pious scribes explained its success by elevating the incidents which accompanied that escape into a series of convenient miracles. The driving back of the Sea of Reeds by an east wind, the timely arrival of the autumn flight of quail, the gathering of "manna," the piercing of an impervious layer which revealed a spring—were all ascribed by them to the friendly intervention of Jehovah, the God of Sinai. But, though these marvels have attracted the wonder-loving for thousands of years, they rather tend to discredit the narrative to the more critical audiences of to-day. Some have tried to explain them away, others have doubted the whole story. I do not propose to do either. Supernatural intervention apart, the problem of how Moses led his tribesmen, first to safety in Sinai and then, after forty years, to within sight of the Promised Land, is of considerable interest to those who realize the difficulties he was up against.

First, I would suggest that the escape of the Israelites, even if miraculous, was by no means as sensational as the flight, in our own times, of the Sanusi inhabitants of Kufra from the Italian bombing. There, hundreds of men, women and children, without preparation, without organization, without transport, with only the food and water they snatched up as they ran, crossed hundreds of miles of waterless western desert to Dakhla Oasis. Hundreds perished but hundreds survived. Had I been asked beforehand whether such a thing were possible I would have replied "No!" Yet, it did happen. Future historians are going to doubt the happening.

Moses was confronted with the task of conveying out of reach of the pursuing Egyptians some 600 families—the late Sir Flinders Petrie's translation of *alaf* as "families" not "thousands" is very plausible—over a wilderness with, speaking broadly, only two feasible routes across it. I exclude a traverse of the central waterless plain of Northern Sinai as impassable by the great herds of sheep, goats and asses which must have accompanied a people in the state of culture. True, the Hagg caravans of Islamic times crossed it regularly for centuries. But those were organized expeditions. They carried their provisions with them and, for water, were often dependent upon cisterns which had been filled for them beforehand by weeks of patient toil. Moreover, they were camel caravans, and it is very doubtful whether the Israelites, when they lived in the Land of Goshen, possessed camels. Certainly the Egyptians of that age did not.

It is possible that they made direct for the Promised Land by the main route from Salhiya to Rafa, followed by the trade caravans of all ages and, in part, by the railway of to-day. But, it is to me more probable that they made, as the Sawalha and the 'Aleiqat of the Middle Ages did, for the "mountain redoubt" of Sinai or Horeb, where dwelt the friendly tribe of the Kenites. Here the weak Amalekites could be driven out or absorbed and strength could be built up for the invasions, first of Moab and then of Palestine.

In our 1929 journey, near Sarabit el-Khadim, we met a great herd of goats and sheep being conducted along this route in reverse, from 'Aqaba to Suez,

at the foot of the Tih escarpment. Their herdsmen were Haweitat and the Amalekites—I mean the Tarabin—had lifted six sheep off them *en passant*. That reminds one that the Israelites had to fight the local tribes for the grazing on whatever route they did take and, in that, no doubt they found the alliance with the Kenites, the people of Moses's brother-in-law Jethro, very useful. Moses (who can doubt it?) had a plan before he left Egypt and, in his request to Pharaoh to be allowed "to go three days into the wilderness to sacrifice," may we not read an intention to diverge southwards, away from the ordinary route, to a Holy Mountain which he had seen before and which, even before the arrival of the Chosen People, may have been a place of pilgrimage—a proto-Mecca? And, in refusing that request, may not perhaps the prudent Egyptian officials have feared a proposal to invade the region of Sarabit, the home of Hathor, the Lady of Turquoise? But there is no end to such speculations, however fascinating.

To conclude, the principal obstacles to the carrying out of whatever far-sighted plans of invasion and spoliation Moses may have had in his mind at the outset were not material but moral. The would-be lawlessness of his squatters turned nomads had to be checked by the strict enforcement of laws, no doubt old in his day, but codified for us under his name. Such laws as King 'Abd el-Aziz Ibn Sa'ud finds very useful at the present time. For, at the very foot of the Mount, Moses caught them, Aaron among them, fashioning a golden calf, the recollection of some Apis or Mnevis they had seen and worshipped in Egypt.

Three days farther on, they began to bewail the vitamins they had left in Goshen. "Who shall give us flesh to eat? We remember the fish we did eat freely in Egypt; the cucumbers and the melons and the leeks and the onions and the garlic. But now our soul is dried away. There is nothing at all but this manna before our eyes!" [1] Anyone like myself who has suffered from scurvy in the desert must understand and sympathize with that appeal from the mothers and fathers of his host. But Moses, if he understood, did not sympathize. His uncompromising rejoinder has been handed down to us in the Holy Qur'an. "Ye have preferred that which is mean to that which is excellent; get ye down into Egypt; ye shall find what ye seek." [2]

Such a straightforward tenacity of purpose was to lead them, after forty years in the wilderness, to the Promised Land, to three thousand years of war, captivity, persecution abroad, a triumphant return—and yet another war after they had got back. Perhaps the unambitious Sawalha and 'Aleiqat have done better by *not* following in their footsteps. It is certainly ironical that all this action took place on a stage that concealed many million tons of oil.[3]

[1] Numbers, xi, 4–6.

[2] Chapter ii. *Of the Cow*. Sale's translation.

[3] The search for oil in Sinai has been long and costly. One company, the Standard Oil of Egypt, began by drilling four widely spaced wells between El-'Arish and the Mitla Pass. No oil was found though the first bore was carried down for 10,262 feet. Later, they sank one at the mouth of Wadi Feiran which showed a small production of good oil. Unfortunately, the company was unable to agree with the Egyptian Government as to the terms on which the oil was to be exploited and discontinued its prospecting. It had spent over 12 million dollars, between £3,000,000 and £4,000,000 sterling.

The Socony Vacuum and the Shell-sponsored Anglo-Egyptian Oilfields had better fortune. From their newly discovered fields of 'Ain Sudr and the nearby Asl, which came into production in December 1947 and January 1949, about a million tons of crude oil a year are sent to the refineries at Suez, more then half of Egypt's total production.

APPENDIX II

Survey

Professional survey began in Sinai with an Ordnance Survey expedition to St. Catherine's Monastery in 1869 under Captains C. W. Wilson and H. S. Palmer, R.E., with E. H. Palmer, Professor of Arabic at Cambridge, attached to the party. There is an official report and the Professor, who was to lose his life in Sinai in 1882, described his journey and a later one in a lively book, 'The Desert of the Exodus.' Large-scale plans of Gebel Serbal and Gebel Musa were made to throw light on the controversy as to which was Mount Sinai and there was also a reconnaissance map of the route to these mountains from Suez.

I might add that the coasts of both the Gulfs of 'Aqaba and Suez had been surveyed by the sailing ship *Palinurus* of the Indian Navy under Captain Moresby in 1832, and the survey of the Gulf of Suez was repeated by H.M.S. *Newport* in 1870. (In taking down the triangulation cairn on Gebel Hammam Fara'un in 1912, I found a bottle with a list of the officers of H.M.S. *Newport* and a statement that the cairn had been built originally by the *Palinurus*. Also there was a brief chit to the effect that "Captain Nares' galley's crew built this cairn. Dry and windy up here, November, 1870." I sent these papers to Admiral Tizard, the only surviving officer of those mentioned, and received an acknowledgement to the effect that I would find a similar bottle on top of Umm Shomar. This, however, had disappeared.)

Nearly thirty years went by before the Geological Survey of Egypt visited the Peninsula in 1898–99 and illustrated their reports with a series of maps, not based on triangulation. Those of Eastern Sinai were very accurate and beautifully drawn by the late H. G. Skill, but that of Western Sinai was very poor. That was atoned for, to some extent, in 1912–14 by a 1/50,000 topographical and geological map of "West central Sinai," a beautiful piece of hachuring, by the late Dr. John Ball, afterwards the first Director of the Desert Survey Section of the Survey of Egypt.

Meanwhile, in preparation for a possible campaign against the Turks, the whole of Sinai north of lat. 28° 30′, had been triangulated by the Survey of Egypt and mapped topographically by parties of officers from the Geographical Section, General Staff. The personnel of these were changed annually but the work was uniformly directed by Colonel S. F. Newcombe, R.E., from 1909 to 1914.

During the last field season, that of 1913–14, two archaeologists, Mr. (afterwards Sir Leonard) Woolley and T. E. Lawrence were attached to the field staff which, calling itself the Palestine Exploration Fund, crossed the frontier and, with Turkish escorts, mapped the Negeb up to the Gaza–Beersheba line. Woolley and Lawrence published their archaeological results in 'The wilderness of Zin.'

The topographical maps were published on the 1/125,000 scale just in time to be of use in the First World War. So great was the hurry to get them out that an error crept into the graticule. When the work was started, the second order triangulation of the Survey of Egypt had not yet reached the Suez Canal, and the excellent new triangulation of Sinai was provisionally based on an assumed observed latitude and longitude station in the garden of the "Suez Hotel." I say "assumed" because it turned out that, in the thirty odd years that had elapsed since the observations were taken, the "Suez Hotel" had moved its premises by about a quarter of a mile. Consequently, there is a correction of that amount to be applied to the graticule of these otherwise excellent sheets.

During the war a good deal of mapping on the 1/40,000 scale was done along the Suez Canal and the northern coast of Sinai by the 7th Field Survey Company, R.E., raised and staffed largely from the personnel of the Survey of Egypt.

After the First World War a good deal of prospecting for oil took place all over Sinai and the triangulation of the peninsula, south of lat. 28° 30′, was completed in 1921–22. Opportunity was taken to intersect some twenty odd peaks in Arabia, east of the Gulf of 'Aqaba, a useful addition to the very slender list of accurately determined positions in that little known area. The topographical mapping came later and had to be done piecemeal, as credits for the purpose were rather hard to extract from the Egyptian Ministry of Finance. Ultimately, the maps were published on the 1/100,000 scale with the relief shown by hachures. To obtain uniformity, the War Office 1/125,000 sheets of North Sinai were enlarged to the new scale, their contours translated into hachuring, the erroneous graticule corrected and the road information revised. This edition appeared in 18 sheets of North Sinai and 12 of South Sinai.

DISCUSSION

Evening Meeting, 8 December 1952

Introducing the lecturer, THE PRESIDENT (Mr. J. M. WORDIE) said: The lecturer to-night, Mr. G. W. Murray, is a gold medallist of the Society. His medal was awarded for his long-continued explorations and surveys in the deserts of Sinai and eastern Egypt, for his studies of Bedouin tribes and for his unstinted help to desert expeditions.

That medal was awarded in 1936, and since then Mr. Murray has been Director of the Desert Surveys, and head of the Topographical Department in Cairo. He retired about a year ago on the completion of a very long period of service. He is, like many other surveyors, a keen mountaineer and I hope that to-night, when he speaks about Sinai he will not forget the mountainside of that country.

I have great pleasure in introducing Mr. Murray.

Mr. G. W. Murray then read his paper

The PRESIDENT: We have with us to-night His Excellency the Egyptian Ambassador, Dr. Mahmoud Fawzi, and I wonder whether he would be willing to say a few words following the lecture?

Dr. MAHMOUD FAWZI: I would have thought that all the light that could have been thrown on Sinai had been thrown by a searching sun or even by the moon and stars, but after having listened to the very intriguing words of the speaker I find that we needed still more light. Mr. Murray has been well advised to start by talking to us about the people, who are, of course, the soul of the land and the very essence of its existence, for no matter how important a land can be, human beings are more important still.

Mr. Murray was good enough, however, not to mention anything about the occasional storminess of the part of the world of which he has spoken. He did not say how windy and how angry it can sometimes be. Rather, he bestowed upon our gathering, out of the flowing eloquence of his knowledge of Sinai, other pleasant things. But even if Sinai gets angry at times it is somehow, as Tennyson said, like men whose windy ways "are but dust that rises up, and is lightly laid again."

I am greatly pleased and honoured to propose a vote of thanks to Mr. Murray.

Major H. W. HALL: In the winter of 1949/50, I had the pleasure of taking an expedition to the Gulf of 'Aqaba for the Natural History section of the British Museum, and I should like to ask the lecturer three questions.

First, can he tell us the approximate age of the castle on the Geziret el Firaun, at the head of the Gulf. I was told when I was at 'Aqaba that it was a Crusaders' castle. One talks about Crusaders in a very light manner, but there is on the Geziret el Firaun the remains of a very large castle indeed, with big water cisterns inside the castle as deep as this hall and at least 40 feet cube.

My second question: half-way down the Gulf there is a place, which he well knows, called Dahab. I understand that "Dahab" is Arabic for "gold." When we were there we used to have a harbour which is about the only good harbour that gives protection from southerly winds, in contradistinction from the continual northerly wind in the Gulf of 'Aqaba. I looked very carefully for any signs of gold, and I could find none.

My third question is that farther south there is a mangrove swamp, which is, I think, probably the most northerly one in the world. Could Mr. Murray give us any details about that?

While I have this opportunity, I should like to thank the Egyptian authorities and the Embassy in this country for all the help that our expedition to the Gulf of 'Aqaba received from them.

Mr. MURRAY, in reply, said: I have not been on the Geziret el Firaun, although I have seen it. The late T. E. Lawrence visited it on a raft that he made for himself. You will find something about it in his book 'The wilderness of Zin.' There is no reason to doubt that it is of Crusader age, but I have not been on it.

As to Dahab, I included an account of Dahab in my lecture but owing to the time I left it out. It is a wonderful place, with a very nice little anchorage. It has three big groves of palm trees and is the capital of one of the tribes, but it has no inhabitants. The people only go there to remove the dates during the date harvest. Its name is an Arabic word meaning gold, but there is no gold there or anywhere in Sinai, although there is copper. I believe it is mentioned in the Bible as Dizahab.

As to the mangroves, they are on the coast. One of my illustrations was of a camel man looking at the water, which is just about 5 miles to the south. I suppose it is the most northerly mangrove swamp in the Red Sea, but I did not know that they were the very farthest north. There were some big groves on the Egyptian coast, but most of them were cut for firewood by the oil companies. They are certainly the most northerly mangroves that I know.

The PRESIDENT: I am very pleased to express our thanks to the lecturer for giving us a small portion only of his very great knowledge of that region. It is very seldom that we get somebody here who has such an extensive knowledge as Mr. Murray.

Thank you, Mr. Murray, for your lecture.

AN INTERNATIONAL EXPEDITION TO ANTARCTICA

G. DE Q. ROBIN

FIFTEEN YEARS ago the coastline of Antarctica near the meridian of Greenwich was shown on the map as a dotted line. Now this region is one of the better known parts of that continent. The Norwegian flights of the early nineteen-thirties over the coast farther to the east inspired the Germans to make a series of flights over this area during January and February 1939 from the catapult ship *Schwabenland*. They brought back and published during the war a most interesting set of air photographs of an extensive mountain region 100 to 200 miles inland from a monotonously ice-bound coastline. These in turn moved the Swedish glaciologist, Professor H. W:son Ahlmann [1] to suggest a detailed surface investigation of Queen Maud Land, the Norwegian sector of the Antarctic continent.

With the support of the British and Swedish governments, the Norwegian Government made funds available for carrying out a wide programme of meteorology, glaciology, geology and surveying. A committee drawn from all three countries was responsible for planning the expedition which was carried out under the general direction of Professor H. U. Sverdrup of the Norwegian Polar Institute. Captain John Giaever, also of that Institute, was appointed leader of the wintering party.

After a year of careful preparation, the expedition sailed from London on 23 November 1949 in the 700-ton Norwegian sealing vessel *Norsel*, strengthened for working in ice. Her master was Guttorm Jakobsen, a Norwegian who followed a family tradition of excelling in ice navigation. Christmas was spent in Capetown, then the *Norsel* had a rough passage through the 'forties before making a wide detour to meet the whaling factory ship *Thorshoevdi* some 300 miles south of South Georgia. A deck cargo of vehicles, dogs and stores which could not have been risked in the open seas was transferred from the factory ship to the *Norsel* in spite of some swell. Course was then set for Queen Maud Land through open pack ice on 14 January 1950.

The five members of the expedition who joined the *Norsel* from the whaling factory now brought the entire wintering party together for the first time. It consisted then of six Norwegian, four Swedish, and four British members, the last including one Canadian and one Australian. Nine of them were primarily included as scientists, and five for their technical skill or knowledge of polar regions. Although inactive, it was the following three weeks on board *Norsel* that enabled members to get to know each other before the serious work started.

The approach to the continent across the Weddell Sea was not difficult for a well-designed ship like *Norsel*, but the ice was more firmly packed together close to the coastline. A fruitless week was spent probing this ice between

[1] Now Swedish Ambassador to Norway.

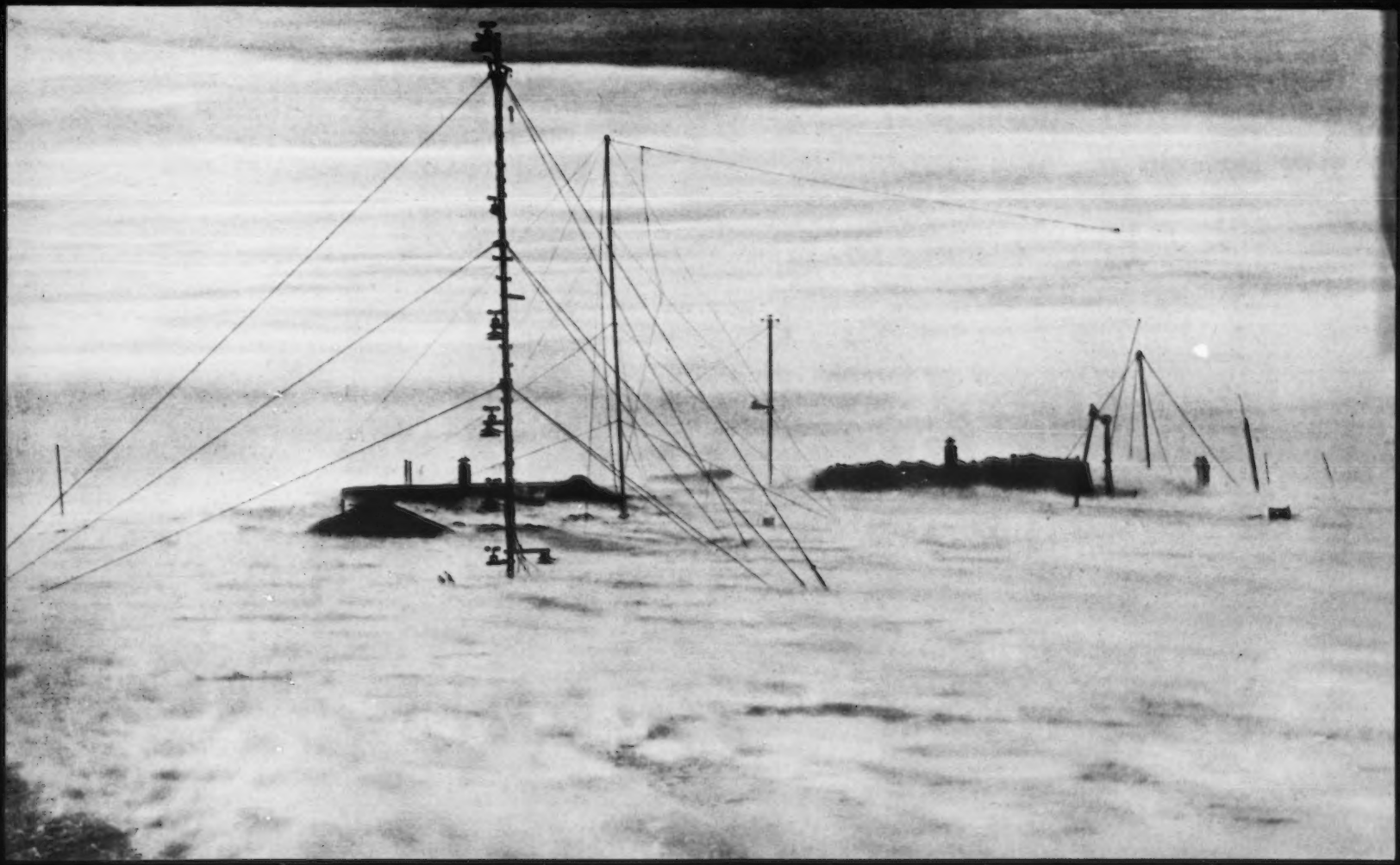
6° E. and the Greenwich meridian, the plotted position of the ice tongue on the latter meridian being only 30 miles distant at one time. As the weather showed no signs of moving the pack ice away from the coast, the attack was moved farther west. With the help of the R.A.F. Antarctic Flight under the command of Squadron Leader G. B. Walford, the coastline was reached at Kap Norvegia on February 3. The light Auster aircraft fitted with floats proved most useful during the following week in searching for a base site. A suitable location was found and a landing effected on February 10. The base, "Maudheim," was then established in lat. 71° 03′ S., long. 10° 55′ W. on a floating ice shelf some 600 feet thick, 3 kilometres inland from the landing point. The three "weasels"—American-built snow-tractors—immediately proved their value by transporting over 300 tons of stores from the ship to the base site in less than ten days. As the security of the base against the weather was assured by February 20, the *Norsel* departed, leaving behind the R.A.F. radio man as an additional member of the wintering party. After being beset in the ice for an anxious week, open water was reached in safety. A call was made at Capetown, then *Norsel* went off to the Newfoundland sealing grounds.

At Maudheim, the living accommodation consisted of two wooden huts which had previously been erected in Sweden. They were some 8 metres square with curtained-off cubicles along each side forming a private cabin for each member. The kitchen and dining accommodation occupied the centre of one hut, while radio, meteorological and medical departments filled the other. Three small huts housed the diesel generators, boring machine and rawin (upper wind) apparatus, while an aircraft crate formed a convenient, though cold, workshop. The hundreds of cases of supplies were stacked to form passageways around the huts, then roofed over with canvas so that as drifting snow covered Maudheim, a convenient underground warren was already in existence. From the distance Maudheim eventually gave the impression of being a forest of masts rising above a low mound which broke the monotony of a flat featureless snow plain.

Although uninspiring in comparison with the scenery of the mountainous regions of Antarctica, the flat ice shelf was almost ideal from the meteorological standpoint. A continuous task for the meteorologists, Schumacher (Norway) and Liljequist (Sweden), was the collecting of observations to enable the weather and climate of Maudheim to be compared with other areas, while specific problems were also studied. To improve our knowledge of the thermal balance of Antarctic regions, a study of incoming and outgoing radiation was made throughout the stay. The wind gradient and temperature gradient close to the surface were examined by recording instruments fitted at different heights on a 10-metre-high mast. Differences of temperature as great as 15° C. were found between the top and bottom of this mast on cold, calm winter days, such gradients being responsible for the striking mirage effects often seen.

The work which made greatest use of recent technical advances in meteorology and which occupied much time was the daily upper air sounding. The aim was to obtain each day, irrespective of the weather if possible, a record of the temperature, pressure and winds of the atmosphere from the surface

Maudheim under snow, 12 November 1950,
with meteorological mast in foreground



to well into the stratosphere, by means of radiosonde and rawin transmitters sent aloft on balloons. As very little has been known about the upper atmosphere over Antarctica, these observations help to fill a large gap in our knowledge of world-wide meteorological conditions. During gales, the release of the balloons carrying this equipment presented some difficulty, but methods were evolved by which they could be sent up in a force 8 wind, and on occasion the release was successful up to 45 knots (force 10). The analysis of the 630 ascents made is proceeding at present. One item of interest is that the disappearance of the tropopause at times during the Antarctic winter was confirmed, temperatures as low as −90° C. being recorded during these ascents. For comparison the lowest surface temperature recorded at Maudheim was −47° C. The table on page 158 gives some idea of the weather conditions there. We had little idea of what to expect in this connection. Possibly the most fortunate feature was the low mean wind speed compared with other Antarctic localities, a great help to our outdoor activities.

The mean annual air temperature at Maudheim of −17·4° C. was shown by the glaciologists to be practically the same as the temperature of the snow (firn) at a depth around 10 metres. They showed this by means of a number of platinum resistance thermometers buried in the ice by means of a Canadian boring machine at various depths down to 100 metres. These were connected to a temperature indicator in the base hut which was read regularly during the meteorological observations. In addition to its use for burying the thermometers, the boring machine produced core samples from all levels so that the gradual transformation from the fresh surface snow through firn to ice could be traced. In a polar glacier the ice is continually below freezing point, so the melting and refreezing which produces these changes in a temperate glacier could not take place. Nevertheless careful examination under the microscope and by microphotograph showed that the average sectional area of the firn crystals gradually increased from 0·2 mm.² near the surface to about 3 mm.² at a depth of 80 metres. Other examinations such as density measurements showed that there was no sharp change in the character of the ice with depth: the only point of note being that at a depth of 60 metres the air channels in the firn became sealed off, thus making the substance ice by definition. The bubbles were then compressed in proportion to their depth.

As well as their studies of changes of the ice with depth, the glaciologists laid out a network of stakes around Maudheim to determine any relative horizontal movement between different portions of the ice shelf. Determination of absolute movement would, of course, have been better, but the nearest point which was certainly fixed, namely exposed rock, was 200 kilometres away. Careful astronomical fixes were tried in order to determine this movement, but the results are of doubtful value as the movement was so small. Apart from these two main fields of study, other investigations carried out during the winter months at Maudheim included periodic observations of the earth's magnetic field, auroral photography, and physiological studies on the adaptation of human beings to a cold climate. The radio department run by Rogstad (Norway) and Quar (Great Britain) maintained daily contact with the outside world.

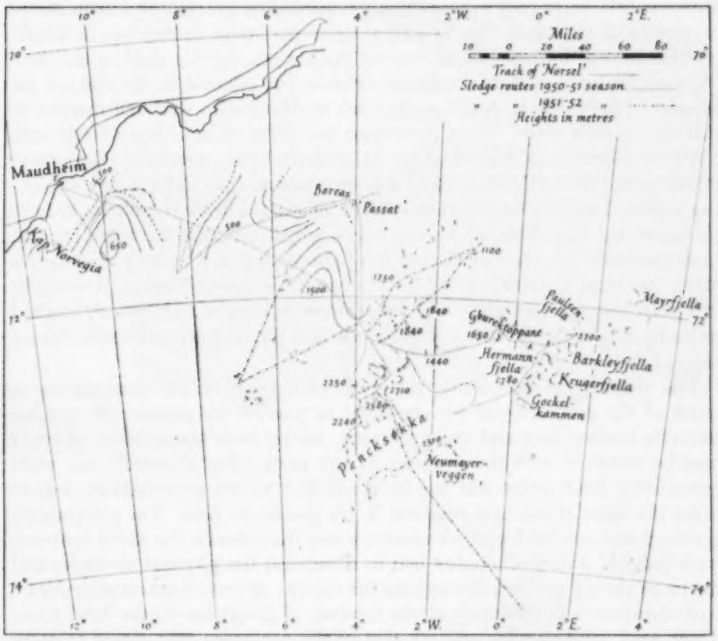
Camp near main Borgen Massif

Some preliminary meteorological data from Maudheim

		Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Mean Temp. °C.	1950			−12·2	−21·2	−23·2	−27·5	−30·5	−24·1	−22·8	−17·3	−10·9	−4·0
	1951	−4·0	−8·2	−18·4	−17·3	−24·6	−25·8	−23·9	−28·0	−24·4	−19·3	−10·6	−6·3
Abs. Max. Temp. °C.	1950				−8·3	−8·5	−11·0	−12·0	−11·0	−10·5			
	1951				−4·5	−3·6	−9·0	−13·4	−14·8	−8·5			
Abs. Min. Temp. °C.	1950		−21·1	−26·7	−37·8	−42·3	−44·9	−46·0	−39·1	−40·0	−33·0	−32·9	−15·5
	1951	−15·4	22·3	−38·0	−38·6	−41·2	−42·8	−41·6	−47·0	−44·0	−38·1	−25·0	−17·3
Mean [1] Wind Speed,	1950				7·3	8·8	6·1	6·9	8·2	8·3	7·0	8·8	6·9
m./sec.	1951	8·8	8·7	6·2	9·6	7·1	7·9	9·9	8·1	8·7	8·8	5·7	4·9
Max.[1] Wind Speed,	1950				23·9	30·3	13·9	25·9	25·8	25·6	26·2	25·9	20·6
m./sec.	1951	26·2	29·8	20·3	29·0	29·3	30·4	27·4	24·2	22·2	29·7	14·1	10·5
Days [1] with Wind	1950				8	10	2	10	11	8	5	9	4
⩾ 7B (19·9 m./sec.)	1951	7	8	3	12	5	9	16	10	11	10	1	0
Days [1] with Wind	1950				0	4	0	1	3	1	1	1	0
⩾ 10B (24·5 m./sec.)	1951	2	2	0	4	3	3	1	0	0	3	0	0
Sunshine, hours	1950			141	77	24	0	0	45	122	182	341	301
	1951	180	175	158	43	11	0	0	36	114	269	360	295

[1] Hourly mean values. B stands for Beaufort force.

During the winter sufficient twilight remained for up to three hours outside work during the calm, cold days. The base seemed rather crowded at this time, with a babel of different languages in the dining-hut. The food, largely of tinned variety, was good. Although it was mostly Scandinavian in character, the queer British tastes in food were remembered in catering. In contrast, the English language was predominant in any general discussion, due to the presence of five British in a party of fifteen. The holidays customary in the three mother countries provided relaxation, but thoughts were centred on the inland journeys to be made in the summer.



Reconnaissance flights by the R.A.F. in February 1950 had located a small mountain group some 200 kilometres to the south-south-west of Maudheim but, mainly because of cloud, nothing had been seen to the south-east. The rough sketch-map made from the flights of the German *Schwabenland* expedition showed that the main mountain region started 200 to 300 kilometres to the south-east of Maudheim, with no rock outcrops in between. As this distance was approaching the range limit of dog sledging parties from Maudheim, it was essential to establish a large depot near the mountains in order that those parties could spend most of their time in these important inland areas. Our weasels provided the only means by which we could establish such a depot in a short time. However, it was uncertain whether the

intervening country would be safe for vehicles, so a complete reconnaissance was first carried out by a dog sledging party.

Preliminary journeys were made during September 1950 up to 75 kilometres to the south-east of Maudheim and a depot placed at that distance on a twenty-four-hour weasel trip. The main reconnaissance party of four men and three dog teams led by Schytt (Sweden), with two men and one team in support, left Maudheim on 5 October 1950. The supporting group visited the first rock ridge found by this party about 200 kilometres from Maudheim before returning. The main party continued over the rising and undulating snow slopes. At 240 kilometres from Maudheim, on crossing an almost imperceptible ridge they were suddenly rewarded by the sight of a magnificent panorama of mountain blocks and slender pyramids decreasing in height towards the north-east—where, beyond the horizon, lay the shelf ice and then the sea. An isolated and prominent nunatak was selected as the site for the advance supply depot. A safe route back to Maudheim was well marked so that the weasels could follow it without the delay of breaking a fresh trail. Under the leadership of Roots (Canada) with the expert mechanical assistance of Ekström (Sweden), two weasel journeys taking eight and five days respectively placed some 8 tons of stores at 310 kilometres from Maudheim to form the advanced base from which dog teams would continue the work into the mountain area. Emergency depots were also established every 50 kilometres along this route to the advanced base in case of accident. Thus by the middle of December 1950, a supply line 300 kilometres long was adequately stocked to enable dog sledging parties to penetrate into the rougher mountain regions beyond.

The majority of past Antarctic journeys have aimed at determining as much of the geography of the continent as possible by people with general interests making long and rapid journeys, taking such observations as could best be fitted in with the progress of the party. Our approach was more specialized. Each party was led by a scientist whose responsibility was to make the most of the opportunities in his particular field. The information gathered and not the length of a journey was the criterion by which journeys were judged. The glaciologists had to determine the physical character and nature of the ice and firn throughout the region, its rate of movement, depth, past changes in glaciation, and the relation of glaciation to the land form. Their work here overlapped with that of the geologists who aimed to make a general geological reconnaissance of the area, studying any points of specific interest which arose. The topographic survey, which was basic to the specialized studies, was carried out by triangulation of all major peaks and nunataks in the area, together with fixes by astronomical observations. Details for the maps were obtained by air photography and stereoscopic ground photography.

On 18 December 1950, the glaciological party consisting of Schytt (leader), Swithinbank (Great Britain), Melleby (Norway) and Wilson (Sweden) set out from Maudheim. Deviating first to the south, then to the north of the direct route to the advanced base, they visited the nunataks Passat and Boreas, which had been named by the German expedition. Although these rose only 220 metres above sea-level compared to the preliminary German

The edge of the inland plateau

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estimate of 1500 metres they provided considerable interest. The polishing action of ice on the rock was visible several hundred metres above the present ice level, but patches of moss and lichens showed no recent recession of glaciation. After spending a week working near the advanced base, the party spent twenty-four days working in the mountain region to the south before making a similar trip east to the Greenwich meridian. Stakes were planted to determine the ice movement in the mountain region, and were measured again before the party returned to Maudheim. At each camp pits were dug and holes bored to study the structure and temperature of the ice, so variations with locality could be determined. On all journeys whenever stakes were planted in the snow for any purpose their height above the surface was always measured. Any party subsequently travelling along the same route would again measure the height of stakes so that a picture of the distribution of snow accumulation could be built up. The trail markers between Maudheim and the advanced base gave the most important single set of such measurements. The annual accumulation of snow varied from practically nil on exposed slopes facing the north-west, to up to 2 metres on slopes facing the south-east. By the time the glaciologists had returned to Maudheim on April 5, this picture was already becoming clear, as bamboo stakes originally $1\frac{1}{2}$ metres high spaced 2 kilometres apart were found with as little as 5 centimetres remaining above the snow surface. Such small signposts made trail following difficult.

The combined survey and geological party departed from Maudheim on 19 December 1950, and travelled directly to the advanced base. While the surveyor, N. Roer (Norway), assisted by myself, measured out and fixed base lines for the triangulation, the two geologists Roots and Reece (Great Britain) examined the nearer nunataks and massifs. The combined party then made a 500-kilometre trip to 72° 14′ S., 1° 12′ E., and extended the topographic survey as far as 3° E. On the return journey a belt of open crevasses were met which necessitated a considerable detour and prevented the party reaching, until the following summer, a plateau later identified as Neumayerveggen. Of the thirty-two days the party were out, eleven were spent taking detailed field observations, eighteen were spent travelling and three lying-up in bad weather. The geological results of the trip were of particular interest. The major ice stream of the area, which reaches the sea almost on the meridian of Greenwich, was found to form a dividing line between two main types of rock. To the southeast, the mountains were almost entirely a mixture of metamorphic rocks, mainly light-coloured banded gneisses composed of quartz, feldspar, micas and hornblende, with the degree of metamorphism differing considerably with locality. On the opposite side of the continent, in South Victoria Land, similar metamorphic rocks underlie Cambrian sediments, and it seems probable they are typical of the basement complex of Antarctica. Much younger flat-lying sedimentary rocks form the major rock type found to the north-west of this ice stream. The cross-bedding of the sediments, the frequent ripple marks and polyganol cracks, and the types of sandstones, greywackes and siltstones all tell a story of relatively rapid and irregular depositions in a strandflat or desert basin environment.

Two days after the return of this party to the advanced base, a radio contact with Maudheim brought news of the tragic loss of three men—Leslie Quar of

the R.A.F., John Jelbart, a young Australian physicist, newly arrived, and Bertil Ekström, Swedish mechanic—in a weasel accident. As this left Maudheim short of people with particular technical knowledge, I waited to join Melleby of the glaciological party to return there as soon as possible. Roots, Roer and Reece started south on March 3. On March 11 Reece was collecting rock specimens, when a flying rock fragment caused the loss of sight of one of his eyes. The party returned to the advanced base so that the doctor (Wilson) could examine the eye. As Wilson could do nothing there, and the wound appeared clean, Reece was allowed to continue field work. A temporary worsening of the condition of the eye later caused the party to wait until April 1 before again starting south. When it did, heavy going and many relays limited the distance covered to 200 kilometres in twenty-four days. However, this was through a mountain region, so useful geological and survey work was carried out. The party finally started back to Maudheim on April 29, with a heavy load of rock specimens. These were placed in a depot 150 kilometres from Maudheim as the cold weather was affecting the condition of the dogs. The party reached Maudheim on May 30, a week after the sun had disappeared below the horizon for the winter. In all, this party spent five and a half months away from Maudheim, as well as journeys made to reconnoitre and establish the advanced base.

While the field activities were in full swing, the *Norsel* arrived at Maudheim on January 6 to replenish base stores and to enable a programme of air photography to be carried out. Among those on board was Dr. H. U. Sverdrup, the expedition director, and Dr. Brian Roberts of the Scott Polar Research Institute. As an oceanographer, Dr. Sverdrup took advantage of the visit to measure the temperature, currents and salinity of the sea alongside the ice shelf. Some flights inland were made by the Norwegian flying unit under Kare Friis-Baastad in a medium aircraft (Polar C.5), but the programme was greatly hindered by bad weather, and shortly before departure the aircraft was damaged in an accident. The *Norsel* sailed on January 30 and made a quick passage out of the pack ice. Three new members joined the wintering party, including an interchange of cooks with *Norsel*.

At Maudheim on 23 February 1951 repairs to one of the weasels were completed and Ekström and Hallgren took it out for testing. Jelbart and Quar accompanied them to collect stores from the landing-place. Although the weather was clear on leaving Maudheim, low fog coming in from the sea caused the party to misjudge position slightly, and the weasel suddenly plunged over an ice cliff. Of the four occupants only Hallgren (Sweden) managed to swim to the precarious safety of an ice floe from which he was rescued some hours later. This tragic accident (to which I have already referred) was both a severe personal blow, and a general loss to the organization as, for one thing, it left the party without a trained mechanic.

As a consequence, it was necessary to economize in the running of diesel engines during the second year so as to avoid the necessity of a major overhaul. Their use was therefore limited to some three hours per day during meteorological and radio routines. The 24-volt battery lighting system, charged by wind-powered generators, helped illuminate the base, but the paraffin pressure lantern formed the mainstay of the lighting that winter. Thus this second winter was in some ways more primitive than the first, but there were

certain compensations. Overcoming the difficulties caused by the loss of the mechanics provided a challenging task. The scientific results of the long term researches were reaching satisfactory proportions, and there was still the remaining summer's field work to be planned. To assist this planning, particularly of the air photography, the previous summer's surveys were plotted, and the relationship between the German sketch-map and the careful ground survey at last became apparent. Some of the German air photographs were then identified with recognized peaks, although the heights shown on the German maps were found to exceed our carefully measured values by 1000 metres and more.

As the condition of Reece's eye gave cause for worry, Wilson consulted a specialist in Sweden by radio who advised that the damaged eye be removed. After careful training of assistants and a considerable amount of improvization of instruments, the operation to remove the eye was successfully carried out. Three days later Reece was busy making dog pemmican, and he subsequently took full part in the last season's field journeys.

The last summer's work was a case of everyone straining very hard to complete a comprehensive and balanced set of results in their specialized fields. In addition a programme of measurements of ice thickness was included as this had not been carried out during the first summer owing to man-power shortage.

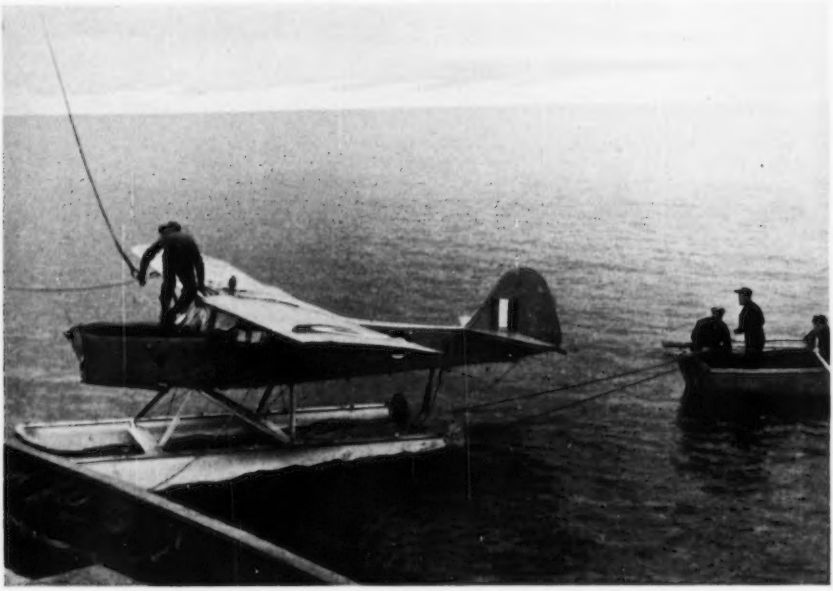
That Spring the first need was to depot additional supplies for the dog sledging parties. The two remaining weasels set out at the end of September 1951 and laid a depot 240 kilometres from Maudheim. One dog sledging party started out three days ahead of the weasels and marked a safe route round a crevassed area which had given trouble the previous year. A second party followed shortly afterwards. The dog sledging parties had all reached the advanced base by October 17 with the stores from the 240-kilometre depot, but their journeys south were delayed by a four-day gale.

The previous season's glaciological work was carried to the conclusion by Schytt, in company with Reece. He re-measured the stakes placed on glaciers in the mountain area to determine the surface movement of ice. The previous season's ice temperature measurements were supplemented by new measurements, and some particular areas were investigated in more detail. Roots, Roer and Hallgren extended the survey and geological reconnaissance by covering additional ground, going as far as 73° 28′ S., 3° 43′ W. on a twenty-nine-day journey. After these trips Schytt was joined by Wilson who had come to the advanced base with the seismic party. Wilson was able to extend his biological collection, particularly of mites, during the return journey to Maudheim, where they arrived on November 29. Schytt then made a final survey of the stakes around Maudheim to determine the movement of the ice shelf. On leaving Schytt, Reece joined Roots and together they completed the geological reconnaissance by trips to the north-east and west of the advanced base before they returned to Maudheim on January 5. Roer completed his surveying operations by a similar trip to the north-east with Hallgren, then made a rapid return to Maudheim covering 300 kilometres in seven days.

After the weasels had completed the 1951 depot trip, they were made

The survey party's camp on the inland ice

"Norsel" alongside the ice quay near Maudheim



An R.A.F. Auster preparing for an ice reconnaissance

Transport train for ice depth measurements

available for the work of the seismic party, which consisted of myself, Melleby and Swithinbank, aided by Wilson until arrival at the advanced base. Mechanical transport was necessary for this party because of the weight of equipment and the distance involved, but one dog team was taken as an additional safety precaution. A sledge caravan fitted as combined seismic laboratory and living quarters greatly speeded up the work of this party, besides introducing new standards of comfort in the field.

The outward journey lasted from October 18 until November 24. The usual route was followed to the advanced base. The weasels were then taken through the mountains, across a broad and crevasse-free glacier, then climbed a series of escarpments to an inland plateau averaging 2500 metres above sea-level. One weasel was abandoned to save petrol, then the party continued some 140 kilometres on to this plateau, reaching 2710 metres above sea-level before finally turning back 615 kilometres from Maudheim. This height was much lower than the German estimates of 4200 metres for the same area in 1939, which height had caused a certain amount of speculation, now unnecessary, as to its origin.

Soundings of ice thickness which were made regularly on this journey showed that the ice sheet covered an unexpectedly rugged underlying relief, comparable with fjord country on the east coast of Greenland. The greatest ice thickness measured was 2380 metres on the inland plateau, and some 2000 metres of ice filled the fjord-type valleys. The ice hills of the coastal region also proved of particular interest, as instead of covering hills or peaks of rock, those investigated appeared to be entirely the result of the accumulation of ice on a relatively flat base below sea-level. The soundings on the ice shelves and the ice hills showed how the latter are the result of the presence of large shoals. This party also extended the glaciological observations of the expedition southwards. The ice temperatures at the farthest point showed that the mean annual temperature at that locality was −40° C., a distinct "continental" effect having caused this figure to fall as one went inland on the plateau. Many gaps in the seismic measurements were filled in during the return journey which began on December 1, the party finally arriving at Maudheim on January 6.

The few people remaining at the base had been kept very busy maintaining the full set of meteorological observations. They had kept regular contact by radio with the seismic party, and also with the *Norsel* pushing southwards through the pack ice. The latter, after a ten-day passage through the pack, reached Maudheim at the early date of December 22. On board was a Swedish Air Force unit under the command of Kapten Baron R. G. D. J. von Essen. Their thorough preparations were aided by fine weather, and their Beechcraft plane successfully carried out a series of flights from 3° E. to 20° W. and from Maudheim to 74° 40′ S. Air photographs taken on these flights will enable a great amount of detail to be added to the results of the ground survey.

As the flight programme quickly went ahead, it became clear that an early evacuation of Maudheim would be possible. Instruments and equipment of value which could be quickly dismantled were therefore packed and loaded on board the *Norsel*. As the landing quay of 1950 no longer remained, it was

fortunate that the bay ice in the harbour lasted long enough to reload the planes on board the ship.

Maudheim was abandoned on 15 January 1952 after a simple ceremony at which the flags of the three countries were lowered together. After a quick passage through the pack, the expedition personnel were transhipped at Santa Cruz on February 14, and the planes were subsequently unloaded and flown to Sweden. All members returned to their respective countries in Europe, where the work of the expedition is now being concluded as the various results are being prepared for publication. At least that will complete the scientific side of a scientific expedition. The other side, the life together in the field, is already complete, and one can look back on a very pleasant and interesting two years in close contact with people of other countries. One major factor in the success of the expedition which cannot pass without mention was the experienced and impartial Norwegian leadership of John Giaever. Quietly but firmly he supplied the encouragement and at times the discretion necessary to harness together such a group of young enthusiasts.

DISCUSSION

Evening Meeting, 27 October 1952

Before the paper the PRESIDENT (Mr. J. M. WORDIE) said: I have been reminded within the last few days by Dr. Brian Roberts that this week marks an important Antarctic anniversary. In three days' time it will be one hundred years since Edward Bransfield, who along with William Smith discovered the Antarctic continent in January 1820, died at Brighton. Bransfield joined the Royal Navy at the age of nineteen and was Master, R.N., on board H.M.S. *Andromache*, at that time stationed on the west coast of South America. William Smith, part owner of the trading brig *Williams* of Blyth, sighted the South Shetlands in February 1819. He returned there again later in the year, to verify his first sighting, and on this occasion he landed in October 1819 on King George Island and took possession for His Majesty King George III. Smith resumed his voyage to Valparaiso and on arrival there informed Captain Shirreff of the *Andromache* of his discovery. There were no telegrams or radio in those days, and Captain Shirreff, acting on his own initiative, at once arranged for Edward Bransfield to return south as master of the ship. This led to the mapping of King George Island and to a voyage still farther south which led to the discovery by Smith and Bransfield of Trinity Land on 30 January 1820. The coast was traced for about one hundred and fifty miles, and Edward Bransfield and William Smith thus became the discoverers of the Southern continent. It was a discovery which remained more or less forgotten in this country until Dr. W. S. Bruce, the Scottish explorer, found the original charts and drew attention in 1917 to this important discovery which Bransfield had made in 1820. The announcement in *The Times* at the time of Bransfield's death simply said that he was "the first surveyor of the South Shetlands lying to the south of Cape Horn." To-night, however, we honour Bransfield as the discoverer of a new continent. At the same time we should not forget Captain Shirreff who, on his own initiative, made a great opportunity open to this country.

The South Shetlands are now within the Falkland Island Dependencies and our lecturer to-night is Mr. Gordon Robin, who first had experience of the

Antarctic there when he went south in 1946–47 and wintered at the South Orkneys.

I am sorry that we are unable to have with us this evening the leader of the Norwegian-British-Swedish Expedition, Captain Giaever, but Mr. Robin has very graciously come in his place. After his experience in the South Orkneys there was nobody more fitted to lead the British party on the joint expedition than our lecturer this evening.

Mr. Gordon Robin then delivered his lecture

The PRESIDENT: I ask Wing Commander Walford, who was in charge of the British flying unit during the first season, to introduce the showing of the coloured film.

Wing Commander BRIAN WALFORD: It is a great privilege to be called upon to say a few words of introduction to Mr. King's film. Mr. King was the South African Government's meteorological observer on the first voyage south. As such he was naturally extremely busy with observations, but he found time to complete a most excellent photographic record of the first voyage.

You will remember that the *Norsel* sailed on 23 November 1949, and after a few days at Cape Town she left hoping to meet the whaler *Thorshoevdi* in the neighbourhood of the Greenwich meridian. But the ships met some considerable distance away to the west and more time was spent in the vicinity than was anticipated. After the transfer of stores from one ship to the other in mid-ocean the film will take us through *Norsel's* successful passage through the pack. This also took longer than expected and we in the R.A.F. were beginning to wish for the arrival of the expedition. When it eventually came we were amazed at the calm and collected confidence of the scientists.

I should like to say how much we owe to the sound and cheerful advice not only of the leader of the expedition but also of our friend Mr. Gordon Robin at that time. A way through the pack was at last found fairly late in the season, and a landing-place spotted soon after, so that the work of the expedition might begin. Two and a half years is a long time to wait to hear, as we have now heard, what great and successful work was done by that team of gallant men we left on the desolate floating shelf ice in February 1950.

The film was then shown

The PRESIDENT said: We have with us to-night the Norwegian Ambassador, and I hope His Excellency will be willing to add a few words.

HIS EXCELLENCY THE NORWEGIAN AMBASSADOR: It was Professor Ahlmann, now Swedish Ambassador in Norway, who made the first proposals for the international expedition to the Antarctic. Those suggestions were made as long ago as 1945. Professor Ahlmann was especially interested in what Queen Maud Land might offer as a field for investigation of climatic change, of which he had found considerable evidence during his researches in the North Atlantic region. Scientists in Norway, Great Britain and Sweden pursued the matter and concluded that not only in the field of climatology but in many others an expedition to the Norwegian territory of Queen Maud Land would quite certainly offer considerable scientific promise. It was not, however, until 1946, when the Norwegian Professor, Hans Sverdrup, took over direction of the Norwegian Polar Institute that the expedition became a going concern. Under the actual stimulus of Sverdrup himself and his staff at the Norwegian Polar Institute, and with the cooperation and financial backing of the Norwegian Government, the expedition was finally launched in 1949. There is no doubt as to the importance of the scientific work achieved. But to me it seems that perhaps it is more important still that the expedition has been an example of what can be done by

international cooperation in science. As you have heard, the wintering party included Norwegian, British and Swedish and their leader was the Norwegian, John Giaever, who was especially chosen for this task because of his experience and temperament.

It is generally agreed that the expedition has been an outstanding success from all points of view and it is to be hoped that it will serve as a precedent for further international work in the sphere of Antarctic exploration in many fields. In the science of meteorology especially, such cooperation is essential if full profit is to be gained from the work. It is singularly appropriate that British and Norwegian explorers should have joined together in this Queen Maud Land expedition. It is a contrast, indeed, to those competitive days of the great explorers, Amundsen and Scott, and I hear that this cooperation in the field now continues in the not less important business of spending holidays together in Norway. I think this sharing of experience and the mutual understanding and sympathy that comes with it are certainly not less important than the exciting scientific discoveries of this first international Antarctic expedition, which our lecturer has so well described.

The PRESIDENT: We also welcome to-night Sir Miles Clifford, Governor of the Falkland Island Dependencies, the territory lying immediately to the west of Queen Maud Land.

Sir MILES CLIFFORD: It was only this morning that I heard this lecture was to take place, and only this evening, an hour or two ago, that I learned that I should be expected to speak to you. I would like to say what a great personal pleasure it has been to me to listen to this lecture, because our lecturer started his Antarctic discoveries under my aegis. He spent a year down in the South Orkneys, but had originally gone there resolved to set up a radar station. We had got him there but, as so often in the Antarctic, things went wrong and the ship could not get the radar or the proposed staff to him. He was left there for a whole year with three Falkland islanders, with no radar and nothing very much to help him spin out the long winter. I visited him the following year and expected to find a very disgruntled officer and a rather demoralized situation. But nothing of the sort. They were all on their toes; everything was spick and span, and it was a credit (however frustrated Mr. Robin may have been) to our effort in the Antarctic.

The Norwegian-British-Swedish expedition which your Society has supported has done, in my humble opinion, a wonderful piece of work, and I await the final results with keen interest. Naturally we followed the adventures of the expedition with close interest although we had to wait for the air edition of *The Times*, which takes about seven weeks to reach the Falklands, to hear what was going on. We were thus able to establish a little temporary contact with the expedition, but the poor men down in the tents had to wait for a year before they got any news at all. I am hoping that some day with this example before us as an encouragement we may see Shackleton's great dream of trans-continental travel carried out by all or some of these modern means.

The PRESIDENT: The hour is late and I think it will be sufficient if I say a brief word of thanks, on your behalf, to Mr. Robin. Those of you who did not know him before the lecture will have realized why the Royal Society of Edinburgh has awarded him the Bruce Medal, which is given for a notable contribution to science in Polar regions. That award we can appreciate after what we have heard, and particularly because it was made to a young man at the outset of his career.

We do thank you, Mr. Robin, for the excellent lecture you have given us.

THE ASSAM EARTHQUAKE OF 1950

F. KINGDON-WARD

IN JANUARY 1950 my wife and I left the Tocklai Tea Research Station in Upper Assam by road, on a journey up the Lohit valley. For the last two years Tocklai had been our base for plant hunting expeditions south of the Brahmaputra, including Manipur and the Mishmi hills. The last named is, for the botanist, perhaps the most fascinating, because the least explored, region in the whole of India; and the prospect of eight or ten months botanizing in the very heart of the mountains behind the Mishmi hills was alluring.

It is not my purpose to describe in detail either the wonderful vegetation, or the fascinating glacial history of this region. But in order to make the short term—and probable long term—effects of the great earthquake of 15 August 1950 intelligible, it will be necessary to give a brief description of the upper Lohit valley.

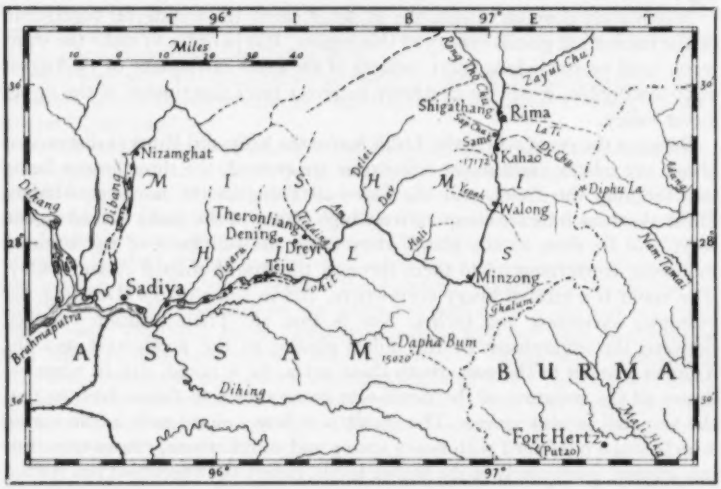
Between the point where the Lohit leaves the hills, and Rima (a distance of about 125 miles), eight major tributaries are crossed, the three largest being the Tidding, the Delei, and the Dav—all rising in the northern Mishmi Hills. As these hills are comparatively high (many of the peaks exceed 15,000 feet), and lie close to the plains, they catch the full force of the summer monsoon, converging on to them through the funnel-shaped Assam valley. The result is a rainfall heavy everywhere, and in some places (Denning, for example) exceeding 200 inches. Nor is that all. Their position, wedged between the escarpment of the Tibet plateau to the north-west and the Yunnan plateau to the east—both these areas, be it noted, dry in winter—draws all the moisture of the north-east monsoon on to themselves, so that the snowfall is also severe. The result is a heavy snow melt in the spring which, when combined with heavy spring and summer rain, causes tremendous erosion, particularly at the higher levels, before the vegetation has started into growth.

On the left bank only five large tributaries enter the Lohit, three of which rise on the Dapha Bum range close to the Burma frontier. At Minzong the Ghalum river joins in from the south-east. Seen from the west, its valley has all the appearance of being the main valley, whose direction it continues—as, indeed, it may formerly have been, when the present main valley to the north was blocked by ice. Evidence pointing to the same conclusion is found in a north–south alignment of high peaks immediately west of the Minzong bend, with Dapha Bum (15,020 feet) south of the river, and an unnamed peak of 17,172 feet about 25 miles to the north. The eastern flank of this range was heavily glaciated and fed the Lohit glacier, while from its western flank flowed the lower Lohit. The joining up of the glacier stream with the Ghalum at Minzong came later.

All the larger north bank tributaries are spanned by wire rope suspension bridges, and though the cables of the Delei bridge had sagged badly, the bridge was quite safe. Even before reaching the Delei, the road engineers

had had to ascend to some height before they could find a good alignment for the path; and as we pushed deeper into the hills, these abrupt ascents of the great buttresses, which shore up the peaks, became more frequent. In places the track was hewn out of the living rock, and being too narrow for a laden mule—it is, I suppose, thirty-five years since a mule caravan passed this way—one needed a steady head round the corners, though there was perhaps no real danger.

As far up as the Hali river, half-way to Minzong, for 2000 feet above the river the mountains are clothed with dense Indo-Malaysian broad-leafed evergreen forest, poorer in species than the Assam foothills but constituting a similar vegetation type. Only on the level terraces and gentler slopes has the forest been cleared and replaced by cultivation and secondary growth,



especially of tall grass. Before the corner is reached at Minzong, pine trees are mixed with typical Indo-Malaysian species right down to the river, sometimes forming thin patches of forest by themselves. By the time one is round the corner and marching north, the change from broad-leafed sub-tropical rain forest to warm temperate pine forest is complete. The change of vegetation takes place in less than 10 miles, and from this point onwards the lower stratum of the forest is inflammable.

Above its knee-bend the Lohit narrows, flowing for some miles in a deep gorge between high, bare cliffs; but before Walong is reached the valley widens again, the cliffs on the west side (whence flow several fair-sized tributaries) receding and becoming less steep. Well preserved terraces are numerous, besides enormous accumulations of boulders and gravel. As we travel north, the climate becomes steadily more arid, a fact quickly reflected in the vegetation. At Rima the valley widens out into a basin some 3 or 4 miles in length by 1 mile in width; the river too widens, and there is actually an

island covered with pine trees out in the stream. A scimitar-shaped bay in the hills on the east bank is occupied by a succession of terraces superimposed on one another, the uppermost being at the very foot of the steep outer range; and a cluster of three or four villages situated on the lowest terrace, in the midst of irrigated rice fields, make up Rima in the broad sense; one of them also carries that name. Its altitude is 5000 feet.

Between the rice fields and the second escarpment is a pond or swamp, where several pairs of Brahminy duck feed in the spring. Parts of three main terraces are well preserved, that on which Rima stands (about 100 feet above the river) being the most important. Only a corner of the second, some 300 feet above Rima, remains; being waterless, it is uncultivated, and uninhabited. The third, the highest and largest, is irrigated directly from the outer range of hills by several streams, and here is grown the bulk of the rice crop. The village of Tooning stands at the top of the gentle slope, 1000 feet above the Lohit.

A torrent—the La Ti—rising on the Burma frontier, separates Rima from the village of La Ti to the south; and 600 or 700 yards north of the La Ti torrent is the official village of Shigathang, where a small timber monastery stands on a square platform of flat stones; but Shigathang was burnt down during the New Year celebrations in February before we got there—all except the monastery—and the crowd of small officials who annually descend upon Rima during the brisk winter trading season were quartered in Rima village.

Half a mile north of Shigathang is the confluence of its two branches, the Rong Thö Chu flowing from the north-west, the Zayul Chu from the north-east. The latter is generally regarded as the main source of the Lohit—an honour to which it has no undisputed claim. Rice fields are plentiful for 20 or 30 miles up the former river, but there is no more rice cultivation up the almost uninhabited Zayul Chu.

Within 10 miles of the confluence, in every direction, the mountains reach 15,000 feet or higher, the average slope of the flanking ranges being 60°, though the cliffs immediately above the river are often vertical (or nearly so) for several hundred feet, and in places for much more. Between Shigathang and the confluence a rope bridge spans the Lohit.

The Rima basin, where not cultivated, supports thin pine forest, with bracken as undergrowth; or thorn scrub. In sheltered ravines, such as the La Ti, a thicker growth, including a much greater variety of species, is the rule, a large Pyracantha (*P. angustifolia*) being particularly abundant. In the stony fields, scattered trees of Rhus and willow are prominent; and in March the terrace is white with pear blossom. The pine forest extends to 7000 feet or higher; above that is solid temperate forest, with a mixture of conifers and broad-leafed trees.

When we reached Rima in the first week of April, the forest fires, which in one place or another had been burning since the previous November, were finished. These fires, started deliberately for the purpose of improving the grazing of a few cattle, or accidentally by careless campers—or even playfully by children—needlessly devastate considerable areas, though the upper valley is so sparsely populated that, apart from the permanent rice fields, only a

fraction of the cleared area is under cultivation in any year. This suggests that the population is diminishing, and derelict rice terraces at various places between Walong and Rima point to the same conclusion.

The annual fires not only check the growth of pine forest, but entirely prevent the growth of broad-leafed forest, except in the gullies. Pines appear to be the only seedling trees which can withstand the grass fires, but even they perish when the whole forest is ablaze. It is certain that a few broad-leafed trees, including *Quercus glauca*, would be well established if it were not for these fires. On one occasion I noticed a forest fire at nearly 8000 feet altitude.

Between April and July, the snow melts fast on the hills; but most of the rain is stopped by the outer hills, and the gorge is distinctly arid. Even so, the torrent beds are full, and the Lohit, whose source lies partly in glaciers on the Tibetan escarpment, is in high flood throughout June and July. The heavy winter snowfall is, of course, not immediately reflected in the Lohit, which reaches its lowest in January.

Such, then, is the background against which we must view the great earthquake, and assess its immediate and probable future effects.

The earthquake struck without warning an hour after dark on the night of 15 August 1950; that is, at about 8 p.m. local time. There were no preliminary tremors—unless a slight, an almost imperceptible jolt immediately preceding the main shock can be called that.

We reckoned that the main shock lasted five or six minutes. It was certainly of long duration and extreme violence, the motion being vertical, as though the crust of the earth were caving in, but found difficulty in getting through the hole. The illusion of everything falling down an immeasurable shaft was, of course, heightened by rocks pouring down the mountain sides all round us with a fearful clatter.

We lay on the ground outside our tent, which was pitched on a low sandhill just outside Rima village; the vibration was so rapid as to suggest the roll of kettledrums. Dark as it was, we could see the ridges silhouetted against the paler sky, with their fuzzy outline of dancing trees. The noise was terrific, petrifying, and long continued as whole hillsides, studded with pine trees, slid into the valley. These external clatterings quickly drowned the internal rumblings deep within the crust. But the strangest noises of all came at the end of the shock, when five or six consecutive explosions, all exactly alike, following each other at intervals of several seconds, were touched off. These muffled booms—they sounded like Ack-Ack shells bursting high in the sky—seemed to come from the north-west; that is to say, from right over the spot where seismologists have placed the epicentre of the earthquake, a few miles up the Rong Thö Chu. They were heard on the plain of Assam 150 miles distant, and in Myitkyina (north Burma) 200 miles away.

During the following three weeks while we remained in Rima—that is, until September 7—I was able to examine some of the local effects. Superficially these consisted mainly of landslides, which continued for months so unstable had the slopes become. The exposed flanks of the gorges which slit the ranges on both sides of the Lohit were frequently scraped clean in the first shock, and continued to pour down avalanches of rock at almost regular intervals. The dazzling whiteness of the scars was due to the nature of the

granite and gneiss of which these mountains are composed. Nevertheless, I was rather surprised how quickly the mountains had succumbed to the main shock, and to the many aftershocks and tremors which followed for weeks, each preceded by a noise like distant thunder. No doubt this was due to a combination of causes—the steepness of the slopes, the burning of the pine forest, the leaching of the granite, and to climatic weathering in a region where the range of temperature, though not excessive, is considerable.

Many of the lower ranges, not only within the Rima basin itself but up and down the gorge, undoubtedly consist of loose boulders, sand and gravel, or are covered with a blanket of such material. The numerous gravel terraces prove that the Rima basin was formerly filled with gravel to a height of at least 1000 feet above the present river level. Other loose accumulations are certainly moraines, while still others are alluvial fans washed out of the ravines.

In the alpine valleys, too, there is always an excess of weathered material, and much of this was shot into the torrent beds. What happened to the Rima and Tooning terraces was typical of all; their scarped edges crumbled and slipped; long, narrow fissures opened; in places the ground sagged and caved in, though I saw no deep cavities. The high river cliffs, of course, gave way in many places, and wherever a footpath ran parallel with the river, it was cracked down the middle, often for long distances, though the crack was never wide enough to put a foot in. Small fountains of fine silver sand—almost silt —were thrown up like worm-casts. Ploughed fields were often badly churned up; but the fact that the rice fields were deprived of water was only indirectly due to the earthquake, the main irrigation channel having been blocked by a rock fall close to where it led off from the La Ti torrent, a mile from Rima. It was cleared within a few days.

Going about the Rima basin from the river bed to the slopes above Tooning on the topmost terrace, and from the La Ti torrent to beyond the confluence, I was alternately amazed at how little the country as a whole had changed, and astonished at the havoc wrought at particular spots. The Tibetan villages suffered comparatively little, though at Shigathang the earthquake completed the work of destruction (which the fire had begun) by throwing the monastery off its plinth on to its side. In Rima every log house was unroofed, which was hardly surprising, since the roofs were of shingles kept in place by stones! Only pent houses, built on to the log houses, where pigs and cattle slept at night, were completely destroyed, killing many of the inmates.

Southwards, the precipice path opposite the village of Samé, which had always seemed to me dangerous—though we had actually taken ponies down as far as the Di Chu torrent—had been swept away, though men could still get by. But south of Kahao it was impassable; hence the only route to Walong was the main path on the right bank, and this, of course, depended on the rope bridge. The rope bridge, however, had been an early casualty, and abortive attempts to get a line across, first at the recognized crossing place, and later a mile or two downstream, left us marooned in Rima. It was three weeks before the river fell sufficiently to allow communication with the right bank to be restored, and this at the old crossing place.

Theoretically there is a wide choice of mountain trails leading out of Rima,

besides the path to India. By crossing the Diphu La, we could reach northern Burma, and eventually Hkamti Long—a journey I had made several times. As aircraft can land at Fort Hertz (Putao), this seemed an attractive route. Or there was the track up the Zayul Chu, whence one could go north, deeper into Tibet, or diverge to Szechuan, or to Yunnan. Finally, there was the path up the Rong Thö Chu, with a choice of reaching either the Dihang or the Tsangpo valley; though this route, like the one to India, depended in the first instance on the restoration of the rope bridge.

Any of these escape routes involved a long and formidable journey, but if the Lohit valley proved impassable, we would have to consider them. In the event, the Lohit valley route, though very difficult, proved possible, whereas the others were not. To great physical difficulties, which might perhaps have been overcome, were added still greater political obstacles which could not. Only the Burma route was safe from Communists, but we heard later that the path down the Nam Tamai river had been ruptured by the earthquake, so that even in the unlikely event of our being able to reach the Diphu La, we should still have been faced by a difficult problem. However, freedom to move about south-east Asia was rapidly being restricted by political, even more than by crustal, upheavals.

Perhaps the two tracks most completely destroyed were those up the La Ti torrent, and up the right bank of the Rong Thö Chu, though the Zayul Chu road (which twice must cross the river by timber cantilever bridges, both reported destroyed) could hardly have been much better. Before the earthquake we had followed the La Ti into its gorge for a short distance, finding ourselves on a narrow path which traversed an exceedingly steep grassy face, where a few tortured pines grew widely scattered. Later, from the opposite bank of the Lohit, we were able to look right into this gorge and see not only that the slope had been flayed dead white, but also that it was swept at regular intervals by tremendous rock avalanches. We heard, without surprise, that a Mishmi village perched on a spur had been buried without trace.

Every avalanche raised clouds of white dust, and as hundreds of them happened every day, the air was always thick with dust. On fine days a strong up-valley wind set in about noon, and by three o'clock a vast white cloud, through which the sun peered like a reddish copper disc, overhung the basin. This dust settled very slowly, yet everywhere the vegetation was thickly coated with it.

Conditions were now ripe for giving birth to heavy floods. But the gorges were quite deep enough to carry them, at the cost of their own beauty. It was not till they reached the plains that floods would become destructive of human life. For example, it would have required a very outsize flood to threaten Rima, which stood 100 feet above the Lohit and lay 600 or 800 yards back from it. Yet one could not altogether discount the possibility of its happening. If either branch of the river became seriously blocked higher up, an immense volume of water might be suddenly discharged when the dam eventually gave way. We might perhaps ignore the possibility of the Lohit itself being blocked *below* Rima, though in fact this did actually happen. However, it happened a good many miles below Minzong, and the Rima basin did not fill up.

It was otherwise with the tributary torrents. These all have their sources in wide glaciated alpine valleys, and become progressively narrower as they descend, finally reaching the main valley through a slit-like gorge in the cliffs. One day we heard a tremendous roaring noise from the direction of the river, and caught sight of a great wave, crested with foam like a bore, sweeping suddenly down from the direction of the Rong Thö Chu. Tree trunks were riding the flood, being tossed about like match sticks. The flood passed in a few minutes.

A more alarming example occurred while we were at Walong in October, when the Yepak, about a mile away, suddenly burst through a dam which had held for thirty-six hours. From where we stood we could not see what was happening, but the noise was ominous, rising to a roar as the flood reached its height, and sinking gradually away. Probably every torrent was blocked sooner or later at least once, for on our way out we crossed several which had had their interiors ripped right out. A peculiarity of these sluiced downstream beds was the iron grey mud which was heavily plastered over the rocks and banks, and its putrid smell. It suggested oil.

So far as I could judge, bird life was not seriously affected, except perhaps remotely; but it was curious that the Rima hens ceased to lay eggs after August 15, till we left on September 7. At dawn on the morning after the earthquake a bird was singing sweetly; but the arid Lohit gorge is a corridor for birds migrating from plains to hills and *vice versa*, rather than a residential area. Another curious effect: the village pye-dogs, which usually barked at night—and half the night—for the mere fun of barking as it seemed, were silent just before, during and long after the earthquake. With aquatic life it was another matter. The Lohit and its tributaries ran so thick with mud that the astonished fish found their world turning solid, and were liquidated accordingly. It was, of course, difficult to extract them from the waves, but we acquired one or two, and excellent eating they were. It seems highly probable that every living thing, plant or animal, must have perished slowly or suddenly, stifled by the mud which for months clogged the waters. (At Dibrugarh, Assam, an analysis of the Brahmaputra water gave 17 per cent. of solid matter!) The day before the earthquake the La Ti was a lovely blue-green, and crystal clear. From the sixteenth onwards it ran thick soup.

But it was, of course, the vegetation that suffered most, and most obviously. The number of pines which were hurled into the river from the lower slopes was prodigious; they came racing down on the crest of the Lohit flood in endless procession, a few helping to form log jams on the island while most passed on. Whole hillsides covered with forest peeled off like wet paper from a wall and slid into the ravines in a wild confusion of rocks and timber. Many trees, hit by flying boulders, snapped off short; but some showed small rocks embedded like bullets in their trunks.

It was not uncommon to see shrubs apparently unharmed on a gravel bank dying where they stood, as though of shock. They were undoubtedly shrivelling from lack of water; but whether some underground source had been switched off, or the gravel had been so badly shaken that the finest rootlets had parted company from the main root system, I could not tell. They could hardly have died as a result of dust clogging their foliage, for all vegetation

suffered in the same way, and had it been lethal, plants must have perished wholesale. The first rain—and some showers did fall even in Rima—washed off most of the dust, and though the film was renewed, there were periods of relief. On the whole the summer in Rima is a rainless season, with high temperature and humidity, a dead time for the vegetation. That dust caused a certain number of casualties seems likely. We ourselves were continually breathing dust, and our skins were powdered with it.

The water shortage was acute. Hitherto we had drawn our supply from the La Ti irrigation channel; but no river water was any longer drinkable. I found a small spring which had worked its way to the surface at the base of a terrace cliff; but when after a few days that ran dry, we had to draw water from holes dug in the still wet paddy fields, or from the marsh where ponies grazed.

On September 1, a patrol of the Assam Rifles from Walong, who had been up the Di Chu gorge at the time of the earthquake and had camped at the hot springs,[1] arrived in our camp. They had found it impossible to return to Walong down the left bank of the Lohit, so had, like ourselves, come to Rima. They were almost out of rations, which we luckily were able to supply, but only at the cost of curtailing our own survival time in Rima since the local people could spare us no more rice. It became imperative to get rice from Walong, or to return there ourselves. We continued to urge the headman of Tooning to put up a new rope bridge without delay, and now at last something was done.

Meanwhile rumours circulated freely, some from words shouted across the Lohit, eked out by signs, some started by new arrivals. How these came to Rima nobody seemed to know, though it was said that men had come down the Zayul Chu. However that may be, there were stories of villages wiped out, of fighting between Chinese and Tibetans, and of shattered paths and hold-ups. We even heard that the Assistant Political Officer for the Mishmi Hills, who had come up to Walong by reason of the Chinese advance into Tibet, had been killed. But until communication had been established with the left bank, from that side we could be certain of nothing.

However, we were greatly cheered when on September 5 word was brought that the local people, assisted by the Samé villagers, had at last got a line across the river, the level of which had dropped. By the sixth, two rope bridges were in position, one a two-way Mishmi cane rope, the other a Tibetan rope of twisted bamboo sloping to the right bank.

On the morning of the seventh we all set out for Walong, crossed the Lohit safely, and reaching Samé in the afternoon found a rescue and bridging party of the Assam Rifles, who were on their way to our assistance. They had brought rice, some medicine for my wife, and a note from the Assistant Political Officer—who had had a sufficiently narrow escape from death to justify the obituary notice—urging us to stay where we were, owing to the perils of the journey and especially of falling rocks. He himself and all his party had had a bad time, their camp with all equipment being buried beneath an avalanche of rock which had killed three of the porters and injured several

[1] The patrol went on as far as the Diphu La, the pass which leads down into Burma, *after* the earthquake, thus upholding the finest traditions of this force.

Hill split in half by the earthquake

Mishmi porters crossing flooded streams

A burst chorten at Rima

Rocks after earthquake embedded in a tree

people. The majority had escaped with the clothes they stood up in and had with great difficulty made their way back to Walong.

We debated whether to follow the Political Officer's advice or go on. As it was now three weeks since the earthquake, it did not seem likely that the danger would be appreciably less in any foreseeable time; and having started in good company, we decided to go through with it. The track was just as likely to deteriorate as to get better, I thought. Moreover, my wife was still rather upset; if she could do the trek to Walong she could have a proper rest and better food, under the eye of a competent and kindly Bengali medical officer whom we already knew.

Next morning the whole party, now swollen to sixty, set out for Walong and quickly crossed the Sap Chu. This torrent had ceased to run for two days immediately following the earthquake, and the ensuing flood had wiped out every vestige of the forest belt which had lined its banks, leaving in its place a residue of stinking grey mud into which our feet sank. The valley had been stripped and sterilized as though by a tidal wave.

The sights we saw during the next three days filled us with amazement. Along one stretch of the Lohit, pine trees were standing in the river with the water half-way up their trunks; and more remarkable still, a long whaleback of sand was visible above the swift, deep waters; this was at the foot of cliffs hundreds of feet high, down which rocks thundered at frequent intervals. Looking across the river we saw the small terrace above the Di Chu, on which our camp had stood five days before the earthquake, strewn with enormous boulders.

Right on the Assam frontier the men pointed out to us the site of the Political Officer's camp, now buried under hundreds of tons of rock; the regular camp site, with its permanent huts, half a mile on, had disappeared over the cliff. No wonder rumour had reported him killed!

We had to make an early start each day, and get as far as possible before the wind rose. It was noticeable that shortly after midday avalanches—which needed no more than a breath to set them off—became more frequent. By afternoon the air, which had become cleaner during the night, was again fogged with dust. On the third night from Samé, after a particularly awkward but short traverse high above the river, we camped near the Walong hot spring; and next day, after almost a mile of clambering over rocks and splintered tree trunks, we marched into Walong at 7 a.m., to be warmly welcomed by the Political Officer.

We now settled down to rest and await events. So far as that was concerned, I was prepared to wait two or three months; first because my wife was suffering from a mild form of shock brought on by all she had been through, and secondly in the hope of reaching the alpine region and collecting seeds. This latter was, however, a somewhat forlorn hope, since if the main path was so badly disrupted, it seemed unlikely that the tenuous hunters' trails which led into the high mountains would be less so. Another good reason for sitting tight in Walong was the fact that the rainy season would not end in the lower valley for another six weeks, and until it did, it would be safer not to proceed.

Walong itself, both the barracks on the middle terrace and the village on

the upper terrace, had escaped with only minor damage, though several slips on both sides of the river continued to pour down endless cascades of rock. What was more fortunate, the excellent water supply was intact; and with plenty of rice and vegetables from the Assam Rifles garden—which the O.C. generously allowed us to share—we lived better than we had done for several months. Luckily for everybody, the wireless was working and kept us in touch with India. From that, and from the Political Officer, a gallant and cheerful young Lushai, we at last heard the truth about the earthquake, which satisfied us that it was a big one. Naturally our relatives at home had been anxious at receiving no news of us for several weeks; but now H.E. the Governor of Assam kindly cabled them that we had reached Walong uninjured.

The weather was fine, with blue sky over the river, and hot, until the tearing midday wind rose and blew till sunset. I now set about finding a track into the mountains which would "go," but without success. At the third attempt I ascended, not without difficulty, up a steep pine-clad slope to a plateau at over 7000 feet altitude. This track had then continued up the ridge, and by the usual cliff traverse, into the upper Yepak valley; but the cliff had slipped badly and there was no possibility of crossing it, nor was there any water on the plateau.

It was not till October that the Walong men, who go into the hills to shoot goral (a variety of Himalayan goat like a small antelope), pointed out a track by which we could reach, if not the alps, at least the temperate forest. I engaged four Tibetan porters, and we set out on the morning of the ninth. In the first 1000 feet there were some difficult and even dangerous spots, but when these had been surmounted the going was reasonably good, and we finally camped on the edge of the forest beside the stream from which Walong received its water supply. From here it proved not too troublesome to reach a main ridge; but though I twice attained an altitude of over 10,000 feet, and silver fir forest, I never quite reached the tree line.

I remarked that south-facing slopes had suffered most in the earthquake. Across the Lohit the high ridges which climb eastwards to the Burma frontier were heavily scarred, both on their southern and western flanks. I concluded that north and east-facing slopes were better protected by their richer garment of forest than were the more exposed southern and western slopes. The cliffs directly facing the Lohit valley wind, however, were as badly scraped as any, and this was due not only to wind and exposure, but also in part to forest fires. There was very little dust on the foliage above 10,000 feet.

On August 15, when the Political Officer's party had been camped on the frontier, his escort, unable to move so fast, was still one march below Walong. On the sixteenth, after a desperate attempt to go on, they had been compelled to give up all idea of reaching Walong, and somehow managed to get back down the shattered valley. Eventually they had reached the plains, proving that the journey was at least possible, though it took them a long time. Perhaps it was as well they had *not* succeeded in reaching Walong, as pressure on the food supply might have been severe.

Shortly after the Political Officer's escort had retired, a party of volunteers from Walong, led by the indomitable Post Commander Jemadar Bir Bahadur

Gurung, and including the brave little Naga compounder, had done the four marches to Changwinti and back. The object of this sally was to obtain a supply of medicines, the Walong stock having been almost completely destroyed. That the party returned safely was a tribute not only to their courage, but also to their skill.

The Political Officer's party was the first to leave Walong, on October 2. We followed on the sixteenth, with a dozen porters for the four of us, carrying all our botanical collections, food for the journey, one small tent, and a minimum of equipment. We knew from reports which had come back that we were in for a tough time.

The first four days to Changwinti included two peculiarly unpleasant cliff traverses high up on the face, where the track had disappeared with the sloughing of the surface rock. Added to the possibility of losing one's balance on the 60°-slope was the perpetual threat of bombardment from above; in fact, getting out of the broken mountains was a far worse ordeal than the earthquake itself had been. It so happened that the earthquake occurred when all snow except permanent snow had melted, and this fact affected the result very considerably. So far as the upper Lohit is concerned, it was perhaps the season of maximum damage. The torrents were low (though by no means at their lowest) and it was difficult for them to keep their channels open in the face of the stuff poured into them. Even a small slip could block them for a day or two, while a head of water was forming behind the dam. Secondly, the slopes were well drenched with water, so that even though the rainy season was nearly over, the heavy surface was in a condition to slip easily. Thirdly, the strong summer wind blowing up the gorge and raising the dust, had some effect on the stability of slopes, making the passage of the valley highly vulnerable.

On the credit side was the fact that the vegetation cover had reached its zenith and was still in active growth; and this would help to hold together the soil. But once a slope gave way, this factor, of course, no longer operated; rocks and trees came down together in one solid piece before breaking asunder in chaos.

What then would have happened had the earthquake occurred in mid-winter? The surface layers would have been drier, and therefore lighter, and at alpine levels, frozen. Hence there might have been less tendency to slip, and that despite the dying down of the vegetation. On the other hand, the danger of snow avalanches would be greatly increased, especially towards the end of winter, when the snow would be more compacted. But as these avalanches take place anyway in the early spring, large snow beds accumulating in the gorges as low as 10,000 or even 9000 feet, this would make very little difference. Even if the earthquake did pitch large amounts of snow suddenly into the main valleys, its quick melting would be a great help in keeping the channels open; with the Lohit at winter level, there would be plenty of room for more water.

We stuck as closely as possible to the original track, considerable sections of which were undamaged. Only when crossing the great screes, some of which were 600 yards or more across, was it necessary to work out a new route. When we reached the broad-leafed jungle below Changwinti I

confidently expected to find fewer slips; surely the thick forest growth would prevent them?

However I had, it appeared, overlooked several important facts. In the first place, the rains in the lower half of the valley were not nearly over when the earthquake smote the hills. September and October are both wet months. Secondly, the outer ranges consist not of granite and gneiss, but largely of shales and schists, which give rise to a heavy greasy soil. Thirdly, I now recollected that vegetation, while it binds soil together, is not less active in disintegrating the rocks. Whatever the reasons, the mountain sides, heavy with water and a great weight of forest, had slipped badly here too. If less numerous than in the dry gorge, the slips were equally extensive, and even more hazardous to cross. One mountain at the base of which we passed, was literally split in twain.

Below Minzong we quickly ran into heavy rain, so that all temporary bridges were once more swept away; on the other hand, we were lucky to find nearly all the permanent suspension bridges—and notably those across the Dav and the Delei—intact, though the footway of the Am river bridge was canted at an angle of more than 30°, owing to the sagging of one of the cables.

My wife had a fall, and though she hardly more than grazed her skin, it turned septic. This accident, and more heavy rain down the valley, held us up for a week. Nevertheless, we reached the Tidding river on November 2, and found men putting finishing touches to the third temporary cane suspension bridge.

Approaching the outer range of hills, I expected to find fewer signs of the earthquake. As we reached the Tidding valley, therefore, it came as something of a shock to observe the colossal damage inflicted—far worse than anything we had seen previously. The steep hills which flank the gateway to the plains seemed to have been turned inside out. Not far above the Tidding confluence there used to be a big rock basin in the Lohit, where the river suddenly widened, then poured through a narrow gap; it was a magnificent fishing pool. Some days after the earthquake, the Lohit itself got blocked at this very point; we saw many trees still partly submerged along the banks. I believe that was the only time the Lohit failed to keep its channel open.

The most terrific sight of all, however, was the Tidding valley. The river, it appeared, had been blocked some distance above Theronliang for at least forty-eight hours—not on the night of the earthquake, but some days later. The result was dynamic. A wall of water 60 feet high had rushed at headlong speed past Theronliang, carrying the rest house and everything else with it. It had roared over the suspension bridge—we could not recognize the place where it had stood—and ripped out the rich lining of jungle on both banks, as though it had been turned on a lathe. The valley was now twice its former width, but it contained nothing but stones piled in vast mounds, with a muddy torrent rushing through the wilderness. It was a graveyard.

We crossed the Tidding a couple of miles below Theronliang, and walked up the right (west) bank, sometimes in the bed, sometimes high above it. Everywhere the mountains were silver as lepers with shining white scars, a country of death. No vestige of bridge, bungalow, sheds, or terrace remained;

only stones and stones. One would never have suspected that this valley had ever been inhabited.

We spent the night of November 2 at a relief camp which had been established on a small plateau several hundred feet above the Tidding, and next morning returned to the site of Theronliang. Curiously enough, the bridle path from here to the Saddle, nearly 4000 feet above, weathered the storm fairly well, and we reached the top, with few diversions, towards evening. Once again a thick mist prevented any view of the Tidding, and henceforth our only view was westwards across the plain. The Lohit had obviously widened out.

Descending the western slope, still in dense forest, we reached the headland on which Dreyi stands, at a height of 5000 feet, to find the rest house in ruins; we slept in another bungalow which was severely damaged but habitable in the circumstances. Below Dreyi, however, the mountain face had slipped badly, and we plunged straight down to a stream bed whence we reached the Sadiya-Teju motor road, 6 miles above Teju, in another three hours. Denning had been virtually wiped out and abandoned. After a day's rest at Teju we travelled by motor lorry to the Digaru river, which was shallow enough to wade, and a friend from Sadiya who had driven out to meet us, took us the last 30 miles.

It was surprising to see the outer ranges to the north dazzling white instead of jungle green. The Sadiya plain appeared to be ringed about with snow to the foot of the hills. There had been marked changes in the rivers too. The Dibang valley had suffered rather more than the Lohit, the river had been blocked, and in the short 30 miles between Nizamghat (where it debouched on to the plain) and Sadiya, it had changed its course, breaching the Nizamghat road and threatening to wipe out Sadiya.

So much sand had been poured into the Lohit that its bed had been raised several feet, causing extensive flooding. Miles of jungle on the left bank had been drowned, and when the river fell in November, a thick deposit of mud was laid down, where formerly there had been sand. A party of men had actually waded across the Lohit above Sadiya—perhaps on the very day it had been blocked at Nara.

But though the ground had swayed about in Sadiya, and considerable damage had been done in many places, all the serious damage on the plains had been caused by flood, but after the earthquake. Nor has Assam seen the end of it yet, for serious floods are likely to recur with the melting of the snows each spring, or the heavy rains, for some years. Any of the four big rivers which debouch into the head of the Assam valley—that is to say, the Subansiri, Dihang, Dibang, and Lohit—may give trouble at any time; but perhaps the most serious threat comes from the two last named, which might easily switch their waters to the south, just east of the railway, following more or less the alignment of the Assam Trunk Road.

No better opportunity for studying plant succession in this area, at all altitudes from 3000 to 12,000 feet, could be hoped for. Slope after slope was completely sterilized, and though many of them will be unstable during late spring and early summer—perhaps for years—and subject to devastating bombardment, the climate is such as to encourage plant life from the start. The battle between vegetation and earth movement is on. Abundant

windborne seeds of many species will reach the barren slopes from the surrounding forests; but the fact remains they must fall on stony ground, and on shifting sands at that. Unfortunately the opportunity to observe what is taking place is being missed, partly from lack of trained ecologists, partly for lack of funds, and partly owing to the remoteness of the region.

However, a large part of the devastated area will one day be reclothed though it is certain that the scars of the great earthquake will be clearly visible a century hence, and possibly long after that. Some of these will be cliff faces, some will be gullies, but many will be mere mounds of boulders.

One may surmise that the wounds will heal from the edge inwards, as is the way of wounds; plant life will creep slowly out from the living formation tissue, consolidating the ground as it advances. Amongst the earliest populations are likely to be many *Compositae* and grasses. Mosses and ferns, so abundant in the forested ravines, will be little in evidence because of lack of water and shade. There are plenty of local plants with wind-borne seeds belonging to numerous families. Pines will certainly be amongst the first trees to appear up to 7000 or 8000 feet; and, indeed, it was chiefly pine-clad—that is, exposed—slopes that slipped. Rhododendrons also have wind-borne seeds, and may predominate, with birch, poplar and willow, at altitudes of over 8000 feet, but only where moisture and shade are available.

In the Indo-Malaysian forests nearer the plain, regeneration is likely to be more rapid, and more complete. It is impossible to prophesy what the succession is likely to be, though one might hazard that alder will figure amongst the first trees. But it must be remembered that in the arid Lohit gorge, open pine forest is the dominant vegetation type between 3500 and 7500 feet, and that the sheer cliffs are almost bare in any case. The earthquake has made more such barren ground.

In February 1951, when Dakotas were dropping supplies to the outposts scattered round the head of the Assam valley, my wife and I on two occasions went as passengers to Walong. We had a fabulous view of the shattered ranges, which lost nothing in dramatic appeal when seen from the air. All the way up the gorge we flew about 3000 feet above the river, the mountains towering up on either side of us; from here the buttresses up which we had climbed, and the nerve-racking traverses, looked utterly impossible. What did seem surprising was, not that some of the side valleys had been blocked, but that any should have escaped being filled in like a grave. It will be a pity if the entire region has not been photographed from the air.

The area over which considerable or great damage was done extends from Rima north-westwards across the eastern Himalayas to the Tsangpo, above the gorge where Tsela Dzong was destroyed, and south-eastwards to northern Burma where the bridle path up the Nam Tamai was badly damaged. The principal rivers in the shaken area—any or all of which may be involved in floods—include: in Assam, the Subansiri, Dihang, Dibang and Lohit; in Burma, the Nam Tamai and the Adung. How far eastwards in the direction of the Salween river the disruption extended is unknown. But there seems no doubt that the earthquake, centred on the neighbourhood of Rima, affected more or less permanently a block of highly mountainous country which to west and south alone covers some 50,000 square miles, and to north and east probably no less.

PROBLEMS OF MODERN LIBYA

W. B. FISHER

RECOGNITION IN December 1951 of full Libyan independence brought into being a new state that is imposing in extent of territory, but only slenderly endowed with natural resources, and hence supporting a population of less than one and a half million. As a geographically isolated area lying well to the south of the main currents of activity in the Mediterranean, Libya is overshadowed in many ways by the more powerful units of Egypt and French North Africa. Unlike some of the Levant states, intrinsic poverty in resources and inhabitants is not compensated for by a favourable location, which might act as the façade of a larger and more productive hinterland. Libya is unlikely to become a route-centre of the first importance; no oil pipelines cross its territories, and its strategic potentialities, though not unimportant, are less prominent than those of Egypt, Cyprus, Malta and Turkey.

The fact that the new state of Libya has adopted a federal instead of a unified system of government—there are three autonomous territories, Tripolitania, Cyrenaica and the Fezzan—can from some points of view be considered a reflection of geographical conditions. The country consists of a discontinuous mosaic of better watered and settled territory, embedded as it were in wide expanses of arid or semi-arid land. A more productive zone lies along the Mediterranean coast, but this is by no means continuous, being broken by expanses where semi-desert and steppe land reach the sea. Many regional names are taken from local settlements, like Cirene, Barce and Tripoli, and this fact, with the piecemeal Italian conquest during the present century,[1] is a further indication of the scattered nature of the main centres of occupation.

Libya cannot be said to have marked unity, except that imposed by the presence of the desert, which gives to the wetter marginal areas an interconnection in much the same way as a closed sea can be said to unite the lands on its borders. The concept of Libya as a kind of Aegean or Mediterranean, with scattered settlements following a way of life fundamentally similar in basic pattern but with regional differences, is not without usefulness, and in a few respects the political evolution of the modern state shows a certain parallel with that of the Greek or Phoenician city-states.

Structurally, the whole of Libya forms part of the great African table, with Archaean basement rocks underlying much of the region. Upon this ancient series, and disposed in generally horizontal layers with only slight disturbance, occur sediments of Cretaceous to mid-Tertiary age exposed roughly in succession of age, with Cretaceous sandstones prominent in the south, and Eocene limestone in the north. A few districts, notably in the north, show indications of tectonic disturbance; extensive faulting, with lava

[1] Occupation of northern Tripolitania began in 1912, but northern Cyrenaica could not be said to have been wholly reduced until 1929, and the southern oases not until 1932–34.

flows and the presence of hot or warm springs in Tripolitania only. The degree of dislocation was such as to suggest to Krenkel that the extreme north of Cyrenaica and Tripolitania once formed part of a tectonic arc or garland, traceable from north-western Syria to Tunis.[1] This view, suggesting that the hills of the north are fold structures related to the uplands of Syria, the Lebanon, Cyprus, Israel and Turkey, and that their origin can best be explained by Wegenerian hypotheses of drift,[2] has however received little support. J. W. Gregory[3] gives a contrary and more likely explanation in which most of the larger land-forms of northern Libya have been developed by faulting and downthrow towards the north, with an absence of folding movements on any large scale. In Cyrenaica especially, the bold unbroken coastline, which rises inland by several well-marked steps, each defined by recognizable fault-scarps and almost horizontal strata that are only locally deformed or tilted, make it difficult to regard the region as forming a fold-structure. When viewed on the broad sweep of a small-scale topographical map the idea of a folded arc running from Libya through Crete to Cyprus and Syria is attractive; but details of structure within Cyrenaica point rather to simple fracturing of the plateau surface, and so to a continuance of the "African" pattern of land forms, which are highly characteristic of Egypt and the Red Sea regions.

As for natural topographical regions within Libya there is, in the extreme north of Tripolitania, a small coastal plain some 18,000 square kilometres in area rising very gradually from sea-level, and fringed towards the north and west by lagoons. This plain, one of the main centres of settlement in Tripolitania, is known as the Gefara, and its southern limits are formed by a series of uplands that run fairly continuously west-south-westwards from the Homs-Misurata area towards Nalut, and which give the Gefara a roughly triangular shape. The uplands reach a maximum height of 2800 feet and are basically a series of fault scarps, dislocated and uptilted in many places, and further heightened locally by upwellings of lava. Continuity of the system is broken by a number of fairly deep river valleys, now quite dry except for winter torrents of a few days' duration; and each detached portion of the uplands has a local name, successively the Jebels Tarhuna (in the east), Garian, Jefren and Nefusa. General custom is to refer to the entire expanse merely as "the Jebel."

Just south of the Jebel lies a stony, upland plateau mainly of limestone and sandstone, at a height of nearly 2000 feet in its western parts but sloping gradually down to sea-level in the region of the Gulf of Sirte. This is the Hammada el Hamra, or Red Stony Desert. On the south-east are several lava areas, for example the Jebel es Soda, or Black Hills, giving a landscape similar to that of parts of Jordan or the Hedjaz of Arabia; while on the south-west are areas of loose sand. Between the lava region and the sand seas of the west occur a number of wide depressions, many of which are occupied by oases. This is the area known as the Fezzan. Finally, towards the southern

[1] E. Krenkel, 'Geologie Afrikas,' Band II, Hamburg, 1925.

[2] The theory is put forward that the Tunis–Syrian arc represents a *plis de couverture* developed by continental displacement in the eastern Mediterranean area.

[3] J. W. Gregory, "Cyrenaica," *Geogr. J.* 47 (1916) 330–32.

frontier of Libya, the land surface rises to form the imposing uplands of the Tibesti Ranges of the central Sahara.

Cyrenaica differs from its western neighbours chiefly by the presence of the Jebel el Achdar, which rises sharply from the sea in two well defined steps, to reach a maximum height of about 2000 feet. There is no coastal plain except in the neighbourhood of Benghazi and Agedabia; and as far west as Tobruk, Bardia, and the western side of the Gulf of Sollum the coast is generally rugged, even though inland in Marmarica the land rises to no more than a few hundred feet. Except for the small continuation of the Harug el Asuad across the Tripolitanian boundary, lava fields are not found in Cyrenaica, but loose sand areas are more extensive and continue without a break into Egypt. The oases of the Fezzan have smaller and less important counterparts farther east in two main zones; a northern group comprising Augila, Gialo, Bettafal and Giarabub, with a continuation into Egypt through Siwa and the Qattara Depression; and a southern group including Tazerbo, Zighen, the main oases of Kufra and el Giof. The Sand Seas of Calanscio and Rebiana act as formidable barriers between eastern Libya and the nearby territories of Egypt, the Sudan and French Equatorial Africa. Shifting dunes, sometimes over 100 kilometres in length and several hundred metres high, can obliterate walls, date palms, tracks and even oasis settlements, and loose sand is a major obstacle both to animal and to motor traffic. A number of tracks exist, chiefly running north–south, but as late as 1940 it was thought doubtful that any practicable motor route could be opened between south-east Libya and Egypt, though in fact one such route was found.[1] A sidelight on the isolation of centres of population and difficulties of communication in eastern Libya as a whole is given by the fact that during 1949 only six parcels of internal origin were handled by the postal authorities in Cyrenaica.

Hydrology

In view of the prevailing aridity, most human and economic problems of Libya centre on questions of water supply. But no complete survey of water resources has so far been made, and until the appearance of a report by American technicians who are at present undertaking a hydrological survey under the Point Four Aid Plan, it is possible only to make a few general remarks. There are no perennial rivers of any kind in Libya: torrents flow for a few days each winter but that is all. Water is consequently available only from the tapping of underground resources and by artificial surface catchment, either from direct run-off or from the springs and seepages that exist in certain places, but which are not enough for a continuously flowing stream. Surface catchment seems to have been developed considerably by the Romans and Greeks, who used tanks and small dams across wadi floors; but nowadays such methods are less employed. The Italians, however, made use of run-off from the roofs of their villas and farmhouses built during the 1930's, and in this way were able to place settlements in semi-arid regions, often independent of ground water supplies.[2]

[1] R. A. Bagnold, "Early days of the Long Range Desert Group," *Geogr. J.* 105 (1945) 35.

[2] From observations carried out by L. Dubertret and the author in the Lebanon, it seems that an Arab peasant farmer can live and irrigate his lands, under Mediterranean

10°
Gabès
Tozeur
TUNISIA
Zuara
Tripoli
Homs
Gefara
Tarhuna
Gariani
Nalut
Giado
Beni Ulid
Mizda
Scemech
El Gheddahia
Grand Erg Oriental
TRIPOLITAN
Gadames
Derg
30°
Hamada el Hamra
Edeien Ubari
Edri
Brach
Sebha
Ft Polignac
Ubari
F E Z
Murzuch
Traghen
Serdeles
Edeien Murzuch
Gat
Ft Charlet
Tummo
Djado
20°
Bilma
Fachi
N I G E R
Agadem
10°

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FISHER

In spite of the extent of limestone series, interrupted by various impermeable intrusions or broken by faults, free-flowing springs are comparatively rare. In Cyrenaica there are a number of solution caverns below the Jebel el Achdar, some with a fair volume of water. The best known of these is the triple cave near Benghazi containing the so-called Waters of Lethe, but equally large underground pools occur in the Wadi Saf, east of Barce. Unfortunately most of the ground water in Cyrenaica is deep down, and outlets occur either close to or even below sea-level, giving rise to freshets at one or two places actually beneath the sea. Pumping would thus be necessary before any large irrigation scheme could be developed on the Jebel el Achdar, which from the point of view of climate and soils is best suited to agriculture. Only two series of springs occur at high levels; one group flows from the base of an Eocene limestone cliff at Cirene, over 1500 feet above sea-level, and the other in the hills just south of Derna, which exists entirely from this water. In the Gefara of Tripoli, water is known to occur at three levels; at 25–50 feet below the surface, as an artesian flow at 65–120 feet, and finally at a depth of several hundred feet. Full information is lacking, but it seems that though the various water-tables are extensive, they are by no means continuous beneath the entire area of the Gefara, and that in the west the waters themselves tend to be hot and highly mineralized, especially in the region east and south of Zuara.

The southern oases extend in two irregular zones. From southern Tripolitania at Socna and Marada, the more northerly belt runs through Augila, Gialo, Bettafal and Giarabub, to continue through Siwa as far as the Qattara Depression of Egypt. The southerly zone can be traced from the Fezzan to Zighen, Kufra and el Giof. All oases present extremely interesting problems of water supply, but discussion will here be limited to those of central Cyrenaica, where conditions afford a typical sample of the kind of problems that exist throughout Libya. In Augila, Gialo and Bettafal, water occurs at a depth of about 20 feet from the surface, or about 150–160 feet above sea-level, and it is therefore necessary to sink wells. But in Giarabub, and farther east at Siwa and the Qattara, water rises to the surface by itself, forming pools and salt marshes. Because of solution of salts from overlying Tertiary strata, chemical content of the water is generally high, yet remarkably variable. Even over several hundred yards within the main oasis of El Ergh in the Gialo group, it was found by members of the Aberdeen Expedition in 1951[1] that well water varied from the reasonably drinkable to the impossible; but at Bettafal, some 40 kilometres south-east of El Ergh, there was a well of almost fresh water. An analysis of the normal drinking supply normally used by the inhabitants for drinking in El Ergh gave a *p*H of 7·3, and the total of soluble salts, 3·85 grammes per litre. After the experience of Smith [2] and

conditions, from a total water supply of about 2½ cubic metres per head per annum. So with an annual rainfall of say, 200 millimetres, catchment from an area of 13 to 15 square metres per person could be enough to sustain settlement, which is rather surprising.

[1] W. B. Fisher, K. Walton *et al.* "The Aberdeen University Expedition to Cyrenaica 1951," *Scottish Geog. Mag.* 68 (1952) 2 and 3; 69 (1953) 1.

[2] C. L. Smith, "The water of the Oasis of Siwa," *Proc. Egy. Acad. Sc.* 3 (1947) 44–37.

Azadian[1] in Siwa, it is reasonable to suggest that chemical content in the water of oases of this group can vary from 0·5 to 8·5 grammes per litre.

The actual mode of origin of the oases has given rise to some discussion. Their distribution in an arc between the Gulf of Sirte on the west and the Gulf of Alexandria on the east, and the fact that the extreme easterly oases (Siwa and the Qattara) lie close to or below sea-level, has led some investigators to postulate that the whole area was once an arm of the sea, with the Jebel el Achdar as an island to the north. They believe that the present salt basins of the Qattara and Siwa represent vestigial relics brought about by desiccation and slight differential upwarping in the extreme west along the Gulf of Sirte. Point is given to this argument by the undoubted presence of marine mollusca in the surface waters of Giarabub and Siwa.

Another view,[2] and one with which I agree, is that the depressions have been formed by sub-aerial erosion, through solution and wind action at points of surface weakness developed at the crests of anticlines that occur in the Tertiary strata. Actual break-up of the surface could well have been caused first by hydrostatic pressure acting from below, for during the pluvial cycles of the early Quaternary era, or a little before, the "head" of water would be greater and could more easily force a way to the surface. Once developed as relatively small openings, the action of water would be supplanted by that of the wind which came with the spread of aridity in later Quaternary times. Conditions in the Sirte area seem to give supporting evidence for this view. Immediately inland from the coast, there is a fairly well marked ridge strongly dissected by wadis, which towards the east are increasingly covered by blown sand. In the west; rock pavement is exposed, and this, besides suggesting structural stability, does not carry much evidence of very recent marine submergence. These wadis and blown sands seem to add to the argument for a fairly long period of sub-aerial erosion,[3] and the surface topography farther inland does not suggest a single gulf or basin. Rather, it is a complex playa formation, partly covered by wind-borne sand. Moreover, the presence of marine mollusca at Siwa and Giarabub, far from being a residual feature, could be due to modern transplantation of protoplasm on the feet of migratory birds, large numbers of which frequent the oases at the present time.[4]

Associated with the geomorphological problems of the oases is the question of the origin of the subterranean water. The supply at Augila, Gialo and Bettafal may originate in one or several ways; first, from relatively local catchment in the surrounding desert, where there is a sporadic rainfall of between 50 and 150 millimetres per annum; secondly, by more widespread percolation underground from catchment areas on the southern flanks of the Jebel el Achdar, some 200 miles to the north, where precipitation ranges from 300 to 500 millimetres per annum; and thirdly, by percolation from gathering

[1] A. Azadian, "Les eaux d'Égypte," *Notes et Rapports des Laboratoires d'Hygiene Publique*, 2 (1930) 7.

[2] G. W. Murray, "The Egyptian climate: an historical outline," *Geogr. J.* 117 (1951) 422–25.

[3] Arguing from the present observed rate of accumulation of sand in eastern Cyrenaica, a minimum period of about 50,000 to 250,000 years would be necessary.

[4] J. Omer-Cooper, "The Armstrong College Zoological Expedition to Siwa Oasis 1935," *Proc. Roy. Acad. Sc.* 3 (1947) 1–40.

grounds in the Tummo and Tibesti Highlands of the far south. Practically nothing is known of climatic and structural conditions in this last area, though Hellstrom has suggested [1] that the water of Kufra originates from the south, towards the borders of French Equatorial Africa and the Sudan. The most recent view of all is that of G. W. Murray, who believes that the flow of artesian water below the desert is derived from rain that fell in the hills of the western Sudan during an earlier pluvial period, and has taken many thousands of years to percolate northwards.[1] Whatever explanation is adopted—and it is emphasized that no real investigation has so far been carried out in the region of the northern Cyrenaican oases—the economic implications of this question are important. If the water is simply from local catchment, the present supply represents an accumulation of centuries, and its extended use by further drilling would seem to be sharply limited. If however the artesian basin is extensive geographically and maintained by more copious run-off, either from the Jebel el Achdar or the south, then the potentialities are much greater and oasis cultivation might be usefully expanded.

The fact that there are great observed differences in chemical content between the ground water in the Augila–Gialo–Bettafal area and that of Siwa and Giarabub, may throw a little further light on the delimitation of catchment areas. Water at Siwa and Giarabub is heavily impregnated with free gas, which in some wells forms great bubbles consisting of 98·9 per cent. nitrogen, 0·6 per cent. oxygen and 0·5 per cent. carbon dioxide.[2] No such gaseous content was observed at Gialo or Augila, suggesting that the water-bearing strata are very different from those of the extreme north-east of Libya.

Another very interesting feature is the use of saline water for oasis cultivation. It was seen [3] that tilling was done in almost pure desert sand, quartz grains devoid of humus; yet by twice daily watering direct from saline wells, good crops of millet, vegetables and fruit were raised, with tomatoes ripening from ten to fifteen days earlier than on the Mediterranean coast. In view of the tendency in certain other parts of the Middle East for soil salinity to develop on agricultural land when copious irrigation is employed,[4] conditions in the Cyrenaican oases are highly significant. Dr. W. T. H. Williamson, Head of the Soil Science Department at Aberdeen University, gave as his opinion that the presence of a clay fraction in Middle Eastern soils induced critical conditions for the development of salinity. So from many points of view, as a contribution to general soil conditions within the Middle East, further study could well be made of the soil ecology of the Libyan oases.

[1] G. W. Murray, "The water beneath the Egyptian western desert," *Geogr. J.* 18 (1952) 443–52.

[2] C. L. Smith, *op. cit.* The gas is thought to be produced by reduction of nitrates in the presence of compounds of iron, which are abundant in Nubian sandstone. So there appears to be a relationship between the Siwa catchment area and the distribution of Nubian sandstone.

[3] W. B. Fisher and K. Walton, *op. cit.*

[4] This has taken place in the northern Nile delta, in Israel, along the Karun River of Persia and, more recently, in the Nejd of Central Arabia and round Konya in southern Anatolia. E. B. Worthington, 'Middle East science,' London, 1946, 50, and B. A. Keen, 'The agricultural development of the Middle East,' London (1946), 45–46.

Agriculture

Due to the lack of reliable information, analysis of general economic conditions in Libya cannot be carried far; and I emphasize that many of the figures quoted in the succeeding paragraphs, while reflecting the best informed official opinion, are little more than estimates. According to Rowland and Robb[1] potentially productive land of all kinds amounts to just over 14 million hectares; that is, less than 1 per cent. of the total area of the country. Of this 14 million hectares, three-quarters is suitable only for grazing, leaving less than 3 million hectares available for cultivation, both shifting and static. Static or settled farming is in fact estimated to be possible on no more than 550,000 hectares, of which about one-half to one-third is actually in use, the rest being occupied by shifting cultivation.

Most of the land is farmed by "extensive" methods, conditioned by the fluctuation of rainfall, lack of capital, and primitive techniques and implements. But it is frequently said that native strains of seeds used in Middle Eastern and Arab agriculture are in all cases inferior in quality. In Libya, at least, this statement is not wholly true: certain stocks, notably barley and some vegetables, are of good quality; so much so that Libyan barley commands a fairly high world price and in fact forms the principal item in Libyan exports. Lack of grading between good and inferior strains is on the other hand a great handicap.

Table 1. *Land distribution in Libya* (*hectares*)

	Tripolitania	Cyrenaica	The Fezzan
Total of productive land	10 *million*	4 *million*	125,000
Grazing land	8 *million*	3·1 *million*	Nil
Shifting agriculture	1·6 *million*	500,000	Nil
Static agriculture	400,000	145,000	Nil
Actually in use	200,000	50,000	115,000
Forest or scrubland	3,000	110,000	Nil
Irrigated oasis gardens	200	500	2,700
Unirrigated palm groves	16,000	8,000	120,000

The chief crops of Libya are cereals (mainly barley and wheat in the north, and wheat and millet in the south). Olives, which are of Italian planting for the most part and are now approaching maturity, provide an important item of food in the north, and dates are a staple in the south, where consumption averages over 500 grammes per head per day. But unfortunately the quality of the dates is not high, and the best in Libya, which come from Kufra, are not comparable in quality with those of Biskra or Iraq. Estimates give $3\frac{1}{2}$ million as the number of olive trees in Libya, and 12 million as the number of date palms, 10 million of which are in the Fezzan. Figs are also an important crop, as are peaches, apricots and pomegranates. Citrus fruit has recently been introduced, and there are about half a million trees. Quality is unusually high, sufficient to justify export, which has now started on an experimental scale (5000 tons in 1950). The relatively high price obtained makes it possible

[1] F. Rowland, E. Robb, 'Survey of land resources in Tripolitania,' Tripoli, 1945.

to grow the fruit under irrigation involving use of water from deep levels, and raised by light motor-pumps. Vines were introduced under the Italian regime, and there were estimated to be 20 million plants in the whole country in 1951, 85 per cent. being in Tripolitania. The chief use of the vines was in wine-making, and a fair quality in this was achieved; but since the declaration of complete prohibition for Moslems in 1951,[4] viticulture has received a setback, and whole areas of vines were to be seen on the eastern Jebel el Achdar in late 1951 lying untended and unpruned. Almonds, grown alongside olives as a cash crop, number about 2 million trees, and the yield will increase as the trees mature fully.

Table 2. Cereal production in Libya (estimated in thousands of metric tons)

	Average 1935–39	1945	1946	1947	1948	1949	1950	1945–50
Tripolitania:								
Barley ..	26	70	75	1·8[1]	22	141[2]	85	66
Wheat ..	7	8	6	1·0	2·4	8	8	6
Cyrenaica:								
Barley ..	15	35[3]	20[3]	20[3]	40	36	31	30
Wheat ..	18	5	4·5	4·8	7·5	6·5	6·5	5·8
Fezzan								
Barley ..	—	0·4	0·3	0·3	0·3	0·4	0·3	0·3
Wheat ..	—	0·8	0·9	0·8	1·0	1·2	1·1	1·0
Libya:								
Barley ..	41	105	95	22	62	177	116	96
Wheat ..	25	14	11	6	11	17	16	13

Vegetables are important in most localities, and as quality is distinctly higher than in some neighbouring countries, it is thought that an export trade could develop, especially as in some cases the growing season is ten to fifteen days earlier than elsewhere in the Mediterranean. Tomatoes grown in Gialo for example can be profitably sold in Benghazi at the beginning of the season. Consequently further expansion of the trade might be possible, depending on the extent of irrigation in the south and the improvement of communications. Other crops which have shown some prospect of successful development are ground-nuts and castor-beans, the former needing fairly abundant irrigation water, the latter being very tolerant of sub-arid conditions. Cultivation of both is at present limited to the Gefara of Tripoli.

[1] Drought year.

[2] Tripolitanian figures are based on declaration and assessments for taxes, and the figure for 1949 reflects greater activity by taxation officials. Observers state that the 1946 harvest was actually the largest during the period under review.

[3] Unofficial estimates. Official figures show totals of less than a third of the amount given here, although statistics of exports indicate that barley to the value of over £250,000 sterling was exported during 1945–46.

[4] The drinking of alcohol is restricted to Christians and Jews, and in theory an identity card is necessary before drinks can be served in public. But the author was able to acquire some totally illicit palm-wine from a location next door to a police station, and this may give some indication of the way in which the prohibition is observed in one or two parts of the country.

Livestock

With the wide extent of semi-arid territory, animal husbandry plays an integral part in the economic life of Libya, particularly in Cyrenaica where the whole bias of life tends to lie towards pastoralism. Besides providing many of the necessities of life: (milk and milk products, some meat, and wool and hair for clothing and tent-making) animal products form a significant proportion of the export trade of the country, especially for Cyrenaica, where they form the largest single item. Animal herding in Libya has two main phases; grazing of natural vegetation on the steppes and semi-desert imme diately after the start of the winter rains, followed by dry season concentration round wells and cisterns. This may involve fairly complicated and by no means regular migration; and for Cyrenaican farmers especially, animal herding is combined with cereal cultivation. So there may be a complex double rhythm of annual movement; sowing in the north, extensive migration south in later winter, return for the harvest, more restricted movement south later in the summer (governed by the availability of well water), and a final return to the north at the end of the dry season. For some pastoralists the routine is further complicated by the occurrence of a plant, *drias*, which is poisonous to animals if grazed late in the year. Provided animals can graze it during the early part of the year it can be safely eaten again later on,[1] hence for some farmers there is special need to organize an early visit to the drias areas.

The following table, based on very scanty official estimates, summarizes the relative importance of the different animals.

Table 3. Number of livestock in Libya (in thousands)

	Average 1935–38	1945	1950
Sheep:			
Tripolitania	375	331	300
Cyrenaica	461	413	462
Fezzan	no information	15[2]	11[2]
Total	836	759	773
Goats:			
Tripolitania	326	431	309
Cyrenaica	239	445	379
Fezzan	no information	[2]	[2]
Total	565	876	688
Camels:			
Tripolitania	53	57	58
Cyrenaica	18	32	20
Fezzan	no information	6	5
Total	71	95	83
Cattle:			
Tripolitania	34	37	31
Cyrenaica	27	21	32
Fezzan	no information	0	0
Total	61	58	63

[1] E. Evans-Pritchard, 'The Sanussi of Cyrenaica,' London, 1949.
[2] Sheep and goats together.

The predominance of sheep-rearing over other forms of animal farming is due to the triple yield of meat, milk and wool. As compared with that of many other Arab countries, Libyan mutton is of relatively high quality; and owing to the small number of milch cattle (which are kept mainly in Tripolitania[1]) the yield of milk, though small, is important. Quality of the wool is not high, but in the opinion of some experts, capable of improvement; and the recent rise of world prices has had most favourable effects. Goats are often reared on marginal pasture, scrub and semi-desert, where sheep do not thrive, and thus goats play a considerable part in extending the limits of productive land. It may be argued that, as for example in Cyprus, extensive rearing of goats leads to overgrazing and the destruction of vegetation, to soil erosion and to the formation of mobile sand; and that there is a delicate balance, which may have been misjudged, between the number of animals that can usefully be kept, and the over-stocking that leads to soil degeneration.

On the other hand, the goat has its apologist in Evans-Pritchard, who writes: "It is mostly through the medium of the goat that the vast natural wealth of the forests of Cyrenaica is transformed into human wealth. The animal . . . has the great merit of preferring tree and shrub to grass. . . . The forest would be useless to the Bedouin without the goat." [2] The same writer strongly denies that the natural scrub of the Cyrenaican uplands has suffered any major damage from unrestricted grazing; consequently it would appear that a careful survey of the full circumstances of grazing by goats will be an essential point in future developments.

Italian colonization

The continued presence within Libya of an important minority of Italian settlers raises considerable financial, social and political problems that are likely, following Arab independence, to take a sharper turn. In 1939 there were almost 110,000 Italians living in Libya; but most of these were evacuated during the war, leaving none in Cyrenaica or the Fezzan, and only 47,000 in Tripolitania. Of the latter about 30,000 are at the present time urban dwellers, occupied in crafts and small scale industry, as artisans, and as commercial agents and shopkeepers. It is the fate of the remainder, numbering just under 17,000, that presents the most intractable problem for the Libyan government.

These rural settlers now occupy 206,000 hectares of what is classified as the "best" land in Tripolitania, out of a grand total of 383,000 hectares, *i.e.* 54 per cent. of the whole. The Italians live as separate communities, with their own villages and cultural organizations; and up to 1951 they were administered separately through a board composed of British and Italian members, under the control of the Director of Agriculture for Tripolitania. Their holdings were originally of two different kinds, private concessions, and the so-called demographic settlements; the former having, in 1949, 7400 inhabitants and occupying a total of 127,000 hectares, the latter 11,000 inhabitants and an area of 97,000 hectares.

The concessions originated as grants of land by the Italian government to private individuals, and the usual size of individual concessions was 25 or 30

[1] Most Libyan cattle are used for draught purposes.
[2] *Op., cit.* p. 34.

hectares. Private capital was employed to develop the concessions, which were naturally sought on the best available territory and the holding was worked as a small plantation—that is, by Italian direction and capital, together with some unskilled Arab labour. At the present time, the concessions produce a disproportionately large share of the foodstuffs and cash crops raised in Libya, and are more or less self supporting. Their technical equipment (though by now in need of some replacement) and their agricultural technique are in advance of most others in Libya—hence the concessions represent one of the most valuable and productive elements in the country's economy. At the same time, the circumstances of their origin, the social clash involved, and their continued Italian utilization of land in a country where farming is difficult and the Arab population increasing at the rate of nearly 1 per cent. per annum make them from some points of view politically undesirable.

The remaining Italian land is occupied by the demographic settlements which received much publicity during the Fascist regime. Generally speaking, the settlements were often placed on land slightly less attractive to private investment: in other words, of somewhat marginal quality, and heavier capital investment was therefore necessary to bring it under cultivation. Organization of the demographic colonies was undertaken by three governmental agencies, ENTE (Ente per la Colonizzazione della Libia), INPS (Istituto Nazionale della Providenze Sociale), and ATI (Aziendi Tabacchi Italiani). All three provided land and communal buildings such as offices, schools, churches, roads and wells; but there were differences of a financial kind. ENTE and INPS undertook the initial clearing of land, developed the water supply, built farms and provided livestock and farm furniture, while ATI provided merely a farm building, and then made an advance of capital to the occupant.

The ENTE settlers were paid a wage for the first two years, and were under obligation to return all their produce without payment to the agency. Afterwards, the farmer shared his produce equally with ENTE, which still bore all development expenses. Finally, the farmer became free to sell his crops as he wished, but then began repayment of a capital debt calculated on the value of his holding, at a twenty- to thirty-year term, with interest at 2 per cent. per annum. Liquidation of the debt conferred full ownership.

Under the INPS scheme, the occupant was recognized from the start as full owner, or rather mortgagee, but was compelled to sell his entire crop to the Institute at official prices. A portion of this yield was credited each year to the farmer, in order to liquidate the capital debt incurred on taking possession of the holding. Terms of interest and repayment were the same as those of the ENTE.

As the name indicates, holders of ATI farms were obliged to devote the greater part of their land to the growing of tobacco, and the whole output of this was once again taken by the appropriate Agency at fixed prices. The remaining part of the holding could be devoted to other crops, for subsistence and sale, and there were arrangements similar to those of INPS by which the capital debt was repaid over thirty years. During the war, most of the ATI settlements were given over to cereal growing, under the control of the British Administration.

The demographic settlements, initiated mostly after 1935, were in large measure an experiment undertaken for political and social motives, without thought of a strict financial return within a short period. Expenditure of 728 million lire (£22·3 million sterling at present values) was incurred by the development of agriculture alone, in order that less than 110,000 Italian colonists could be maintained: partly to make a visible contribution to the problem of over-population in metropolitan Italy, and partly to erect a functioning Imperial territory that would demonstrate Italy's "mission."

Since the end of Italian rule, the position of the demographic settlements has become precarious. The three Italian agencies have of course disappeared, but none of the tenancies have run full term, and most are less than fifteen years old—that is, still in the stage of dependence on outside financial support. Though the devaluation of the lira has greatly reduced the capital debt, the continued working of the settlements remains dependent on governmental aid. The British, and now the Arab, authorities have found themselves willing or unwilling heirs to the Italian colonial agencies, ENTE, INPS and ATI, with the continuing necessity of supporting the demographic colonists. Consequently, direct financial aid and subsidized electric power have been provided for the Italian settlements.

Table 4. Subsidies to former Italian settlements in Tripolitania (£ sterling)

	1944–45	1945–46	1946–47	1947–48	1948–49	1949–50
Direct subsidy to cover deficit:						
ENTE	18,000	21,000	22,000	27,000	62,000	51,000
INPS	58,000	62,000	52,000	62,000	79,000	80,000
ATI	24,000	2,000[1]	14,000[1]	1,000[1]	30,000	43,000
Total	100,000	81,000	60,000	88,000	171,000	174,000
Electric Power ..	22,000	27,000	48,000	49,000	29,000	14,000
Total advances ..	122,000	108,000	108,000	137,000	200,000	188,000

In addition, remissions of taxes were also granted to Italian settlers.

So, neglecting the value of the tax remissions, the 17,000 colonists have received direct financial aid since 1948 at the rate of nearly £12 per head per annum: a figure only one pound sterling lower than that estimated to be the total annual income per head of the average Libyan Arab, and three times that of the total budgetary income per head of population. It is difficult to envisage how the new Libyan government can find the means, however well disposed, to maintain one section of the community at a level of living so disparate from that of the majority. The whole problem of the Italian settlers can be summarized as follows: first, the circumstances of origin of the concessions and settlements are from many points of view politically reprehensible; secondly, the greater part of the best agricultural land has been alienated from Arab hands; thirdly, the concessions, but not the settlements, can to

[1] Profit, not a deficit, and applied to reduce the deficit on ENTE and INPS.

some extent be represented as making use of European capital to exploit African labour; and finally, the demographic settlements involve a financial burden upon the rest of the inhabitants of Tripolitania.

On the other hand, it is undoubtedly true that the Italian farms are technically more efficient than those in Arab hands, and the majority of them (as represented by the concessions) are financially self supporting. Collectively, both concessions and settlements provide an important share of the food available in Libya, and their presence is sometimes an incentive and a demonstration to Arab cultivators nearby. Then too, the political results in Western Europe of a forced repatriation of the Italian settlers might prove highly regrettable. In its best aspect, the problem of the Italians in Libya provides an opening for generous toleration on the part of the Libyan Arabs, and an opportunity for practical financial help by the United Nations Organization. In a more strictly realist form, as an aspect of power politics, it might be argued that under the delicate political conditions now prevailing in Italy, a repatriation of Italian colonists could ultimately prove far more damaging and expensive for the principal Western powers than an annual subvention on behalf of the Libyan Italians, which would amount at most to less than half a million pounds sterling.

DISCUSSION

Afternoon Meeting, 5 May 1952

Before the paper the CHAIRMAN (Dr. K. S. SANDFORD) said: Our lecturer this afternoon is Dr. Fisher of the University of Aberdeen, who in 1951 led an expedition to Cyrenaica which was organized within that university. Some present may know that Dr. Fisher has also published a book on the geography of the Middle East. We are very glad to welcome him and look forward to hearing what he will tell us of the expedition. I gather that he will be concentrating upon some of the stimulating problems which await geographers in the new kingdom of Libya.

Dr. Fisher then read his paper

Lord TWEEDSMUIR: We are very fortunate to have had such a distinguished Middle Eastern expert as Dr. Fisher to speak to us and to show that fascinating film. He was extremely modest about the expedition's accomplishments, but I feel sure you agree that it achieved a great deal in a very short time. I was faintly connected with finding money for the expedition, and while I suppose that Aberdeen will expect full value for the money spent, I am quite certain that we got not only the value we might have expected but a great deal more as well.

I was enormously intrigued by Dr. Fisher's wonderful résumé of all the problems of that ancient and fascinating country, and there was almost no facet of the economy of the area which he did not mention. Whether it was the impingement of the price of commodities on the market; or the interplay of different races; or whether it was politics; he touched on each in the right perspective.

When the three territories became a united kingdom I was for a period of three months one of the British representatives at the United Nations Assembly, and I can say that it was one of the few events I remember which really united the nations in some sympathetic accord. Having had the honour of being called

upon to speak I shall claim the right to thank Dr. Fisher for the enjoyment he has given us and to ask him two questions. You showed us, Dr. Fisher, a stand of trees and a man with a rifle whose job it was to guard it. Could you tell us what trees they were and how much afforestation there is in the area—how much is possible and how much is desirable?

Secondly, about fifteen years ago I went to the Dust Bowl country in Western Canada and there, on the edge of that Dust Bowl, I realized that it was practically impossible to prevent it spreading. Even in the case of the good farmers who cultivated their land on the best possible lines, there only had to be a dust storm to overlay the cultivated land with dust, for it to be rendered waste. If that is so in Western Canada I should have thought it even more likely in Libya.

Dr. FISHER: The trees are the Aleppo Pine, a native of the Eastern Mediterranean. Altogether there are about 3000 hectares of trees in the whole of Libya, mainly in the hills of Cyrenaica. They are maintained on a rather precarious footing because the lack of fuel is so chronic that almost anything in the form of wood, including window frames from the Italian villas, is immediately taken to be burned. Winters in those hills can be very unpleasant and bleak. When in the region during the last war I had ten blankets at night, so that you can imagine the people do need all the fuel they can find.

In answer to your second question, it is certainly true that a large amount of dust is blown about. Actually on our last day there was a phenomenal sandstorm which covered the whole of Benghazi to a depth of a quarter of an inch and ruined every carpet. I even collected a small sample, scooped up from the middle of my dressing table, although all the windows were shut; and in three or four hours I had enough sand to fill a fair-sized tube. At present I should say there is nothing that can be done to produce a major change. There will need to be a long term attack, beginning with fixation of the dunes, and a spread of education designed to avoid the tearing up of loose vegetation. There are certain low-growing creepers which at present bind the soil a little; all too often they are regarded as useless and are torn up, with the result that the sand is set free and rises. As the final binding element there should be some attempt at farming which does not plough too deeply. One of the main dangers in Mediterranean countries is over-deep ploughing. There is a tendency—I must not say it is any more than that—for foreign experts to come in and say to the people: "What miserable ploughs you use; if only you had good foreign ploughs they would go three times as deep and you would get more and better crops." That suggestion is often adopted, with the result that the farmers produce far more dust than crops. The answer is, I think, the development of a native kind of farming which will aim at conservation, without going too deep; attention to farming; an attempt at fixation of the dunes, and at preventing run-off of the water in winter. Certainly no quick or short term measure will bring about the desired result.

Professor H. J. FLEURE: I have been very interested to hear Dr. Fisher's paper. I feel gratitude is due to the University of Aberdeen for backing up the expedition to Cyrenaica with such generosity and usefulness. That is worthy of Aberdeen. I always felt it was a great centre of enterprise and I am glad to recognize that and express my gratitude to the University for having taken this step.

Dr. Fisher's paper has stimulated many thoughts. One has read so often of the great work of the Romans in North Africa in spreading cultivation. There is no doubt that they did do so, but was it not a little like the effort to spread cultivation in Oklahoma at the end of the nineteenth century? Was it not a

dangerous thing to disturb the soil unduly and probably to spread dust as well? I am not at all sure that the Roman Emperors were as far sighted as some later folk have made them out to be.

Dr. Fisher has mentioned that prosperity in Cyrenaica has arisen from the increase in the olive trees. That suggests to my mind the theory of Sir Arthur Evans who held that the olive tree was a native of Cyrenaica and had spread in the Mediterranean from that country. The evidence was not altogether satisfactory. In fact it was slight, but evidence of the olive having come from any particular original centre is generally very difficult to trace.

I was wondering whether the native folk had tried planting fig trees on any large scale. I do not know the country exactly; I have not been farther west than the desert round about El Alamein. But going towards El Alamein from Alexandria one finds great plantations of fig trees and those trees grow, apparently, in sand if the water level is not too deep, and after a few years they provide a good deal of shade to the soil. It seems to me that for the conservation and improvement of the soil the shading of it from the fierce heat of the sun is one of the most important devices. I have tried to follow it in the country west of Alexandria, and I feel as a result that that is really one of the main necessities. I agree with Dr. Fisher that deep and heavy ploughing is one of the greatest mistakes in those southern areas. The food substance for plants is near the surface. When the lower layers are disturbed and spread over the surface there is a loss of food substance followed by exposure of the soil to dust in large quantities.

I hope that such expeditions will be maintained and that the University of Aberdeen will continue not only to be satisfied with the results, but carry on to achieve still further ones.

Dr. L. M. KRIAL: I was born in Africa, but unfortunately in the south. All the same, I very much enjoyed the lecture and all that the lecturer showed us in the film. Has science anything new to offer in the way of assisting to increase rainfall in Africa?

Dr. FISHER: I think the answer must be "No," unless one can include the results of the rain-making experiments which have had a limited success in certain parts of the world but not in others. There is a remarkable development of cumulus cloud at certain times of the year which sometimes gives rain. It might be possible to produce an increase in rainfall from such a development of cumulus cloud, but the British experiments show that it might be at the expense of a neighbouring region. It is not possible to increase the total volume of water. As things stand at present, excluding possible atomic development, the answer must then be in the negative.

Mrs. STJOHN COOK asked whether British currency was valid in Libya.

Dr. FISHER replied: That is a somewhat complicated matter; it is a sterling area. The bank of issue is Barclays and until recently the notes in circulation were Egyptian. Because of developments in Egypt there has not been the same enthusiasm to carry on with the use of Egyptian currency under British auspices, for various reasons. It was hoped to start a local currency, but questions arose, such as: on what would the currency be based? Would Barclays still be the bank of issue? Could there be a 'ocal bank? If so, what financial reserve should that new bank have to back the currency? I cannot say whether that issue has yet been decided; it had not been up to April 1952.

Mrs. STJOHN COOK: Do you think it is an area which might be visited more?

Dr. FISHER: It is within the sterling area and there are all sorts of treaties and understandings which make the currency position fairly easy. That is one reason why the expedition went there. Originally Lord Tweedsmuir proposed

north Canada, but we were faced with the dollar position. Hence currency is an important point.

Mrs. StJOHN COOK: Is there any difficulty in regard to visas?

Dr. FISHER: Until British rule finished one had to obtain a visa from the British Foreign Office, which I think was granted reasonably easily. Since then I cannot say what has been the position.

Asked what had happened to the abandoned Italian farms in Cyrenaica,

Dr. FISHER said: They have been taken over as standing farms and occupied by any Arab who could get permission to go to them. A few are tied to the British Wheat Scheme, a kind of Government research station designed to increase the yield of cereals on experimental farms. But in the main the Italian farms were just lifted by the local Arabs. Some are now in a bad state. They have been fought over three times. The woodwork has gone and the farmhouses are adapted to other uses: the family lives outside in a tent and the cattle live in the farmhouse!

Mr. A. M. FROOD: Just outside Tripoli there is an old-established agricultural research station with much equipment and too few people to use it. I am sure Dr. Fisher would agree that there are great opportunities for those with technical qualifications, particularly in connection with agriculture, in that station.

I have a question concerning the development of the Libyan State. Dr. Fisher drew a contrast between the societies of the coast and of the interior as a possible line of weakness in future development. Would he agree that another element of potential weakness is the contrast between Cyrenaica as such and Tripoli as such, by reason of the great human gap?

Concerning United States aid under the Point Four Programme for underdeveloped countries, could Dr. Fisher say anything about the progress of that scheme during the last twelve months?

Dr. FISHER: The Point Four Programme has begun work in Tripoli and the first activity was the water survey to which I made a brief allusion. A comprehensive educational programme affecting schools, the actual things taught, and a background for teaching is also getting under way. As there are no higher institutions beyond secondary schools at present the students have to go abroad if they wish for any form of technical training. That is also being envisaged. Another scheme is in prospect for the general development of the Tripolitanian area with the possibility of making a United States commercial air base and all the ancillary developments which go with that. It has come up against a political snag and is at the moment not a practical proposition, but it has not yet been entirely abandoned.

I agree with the speaker about the differences in the two areas. It is, perhaps, pushing the parallel too far, but there might be something of the difference between Scotland and England in Cyrenaica and Tripolitania. There is more amity in Cyrenaica; the people are more accustomed to it, on the whole, as part of their daily life. On the other hand, the advantage of numbers and wealth is with Tripolitania. Cyrenaica has tended in certain respects to look to Egypt. Tripoli is conscious of its position in regard to Tunis. So that I would agree that it is a difficult matter to make sure that both countries feel they have adequate self expression. That is why it is a federation and not a complete country. Each still has its Government and its Prime Minister, which some would consider a little top-heavy for a community of 300,000. To have a Prime Minister for Cyrenaica is a big concession.

Asked whether the population of Cyrenaica was entirely Semitic or whether it was made up of Berber elements as in Algeria and Morocco,

Dr. FISHER replied: That is one of the dangers of making broad generalizations.

I did speak of most of the people as being Semitic, and it is fair to say that that applies to most of the population. It is Semitic in racial stock and fairly unified over most areas. In addition, there is a Berber strain which is found as far east as the Oasis of Augila, just west of Jalo, where the people speak Berber dialects. Certainly it is true to say that there are quite strong Berber elements here and there.

The CHAIRMAN: We have had an active and interesting discussion to which I would like to add one or two small points. Professor Fleure spoke of the olive and his remark called to my mind the delight of Professor Newbury many years ago when he found the wild olive growing on the coast near the old Italian–Egyptian frontier.

On the subject of the water level in Roman times being much the same as it is to-day, you will probably recall that Mr. G. W. Murray whom we hoped would have been with us this afternoon, has published a paper in the Society's *Journal*[1] on much the same subject, and he has come to the same conclusion—that nothing has changed for a long time past, so far as he can see.

Of course there is practically no rain in the south of the area, and when I say that I have in mind that the ground is not very high. The question is where does the artesian water come from? Some think it comes from far south, from Tibesti; that it sinks down in the sandstone and finds its way extremely slowly north. I would like to ask if the same is true of the middle parts of the Libyan desert, with the exception, of course, of Fezzan?

Dr. FISHER: I wish I had time to enlarge upon the most interesting topic of water-creep in the country. The oases near Siwa have a strong content of free nitrogen which rises in bubbles in the wells; I believe it is something like 90 per cent. free nitrogen, the rest being almost all carbon monoxide. In Jalo there is no free gas whatever. Farther west there is sulphur. All sorts of suppositions present themselves. How does the water get there? Where does it creep from, and in what way? Where does it originate? Does it come from the southern part of Tibesti and, if so, by what route does it come to acquire this very marked difference in physical characteristics when drawn from the wells? Analysis of chemical content, even from well to well, shows that there is quite a marked variation every hundred yards. So that the water does present a problem of immense fascination. Also there is the question of its great capital importance. Anyone who digs a new well has the local folk round him in a great state of gratitude. We spoke about starting one in some Roman ruins and the villagers became very interested. They were very disappointed when we said we thought we could not do so. It is a big problem and one which would well repay further investigation.

The CHAIRMAN: It only remains for me to recall the words of Lord Tweedsmuir and to say once more how much we have enjoyed this admirable lecture based on geographical principles, followed by an excellent film.

[1] G. W. Murray, *op. cit.*

OLD SHORE LINES NEAR CAMBER CASTLE

CAPTAIN H. LOVEGROVE, R.N.

IN 1948 I HAD the opportunity of examining the old beach ridges in the vicinity of Camber Castle, near Winchelsea. They lie in a triangular area some $3\frac{1}{2}$ miles long by $2\frac{1}{2}$ miles wide, bounded on the west by Pett Level and the river Brede, on the north by the river Rother and on the east by the sea. Any estimation of shore lines in this area can generally be no more than a minor pendant to Lewis and Balchin's work on neighbouring Dungeness.[1] It has however an interest of its own both because the shingle is rapidly disappearing under the dredges of gravel contractors, and because it seems possible to date a series of these shore lines from as far back as the thirteenth century.

Those who are acquainted with Cinque Ports history will recollect that Old Winchelsea was "drowned" in the thirteenth century and that a new town was then built which was later "deserted by the sea." What exactly happened, how the old town disappeared and the new port became useless has not been satisfactorily explained; but I believe an examination of these beaches may throw some light on the events.

The whole area is shown in the Ordnance Survey, one-inch series, number 184. It is covered in the six-inch edition by maps numbers 49 north-west and north-east, and 45 south-east. Neither these nor the twenty-five-inch maps mark the soil-covered shingle ridges in the immediate vicinity of Camber Castle and a sketch survey was accordingly made of this area (Fig. 1). The survey was not carried beyond the inner edge of that naked shingle which is recorded on the Ordnance Series, both because time would not permit and because all the fulls of the naked beaches are comparatively simple and follow the general lines evident upon the map. The examination of the whole area can be divided into three main sections; a description of the covered fulls near Camber Castle, a general survey of the whole triangle and the dating of certain shore lines.

Description of Camber Castle fulls

Except for the construction of the sixteenth century castle and its outworks and the remains of a late nineteenth century golf course, these fulls have remained virtually undisturbed since their formation (Figs. 1 and 2). Those included in the sketch survey are almost entirely covered by a thin sheet of soil. On their crests grow lichens and short grass interspersed with plants such as stonecrop. The troughs are filled with a rather more lush growth but only in one place, just south of the Castle itself, is the soil sufficiently deep and moist to bear rushes.

For convenience of examination the fulls may be divided into three series. The first, in the immediate vicinity of Castle Farm, is complex in character and the run of the ridges changes rapidly from east/west to south-east/north-

[1] References are listed on p. 206–7.

west. Their roots have been covered by the fulls of the second series but they appear to fan out from a point 400 yards to the south-east of the Farm buildings. Here is a plateau of sand in which is a disused sandpit some 10 feet deep. The plateau marks the northern end of an old sea wall which runs south-south-west across the workings of the New Harbour (abandoned in 1784) and reaches the modern shore line just north of the ruins of the Old Ship Inn.[2] The fulls of this first series are sandy with many shells but little shingle. They are widely spaced with easy gradients and are generally more rounded than the fulls of later series.

Camber Castle itself stands on the fulls of the second series which fan out directly from the sand plateau mentioned above. They overlie the roots of the first series and, starting as four or five fulls running north-north-east, multiply rapidly and swing towards the north-west. They are shingly, especially the easternmost ones, steep sided and set close together. Their pattern is not nearly so complicated as the fulls of the first series.

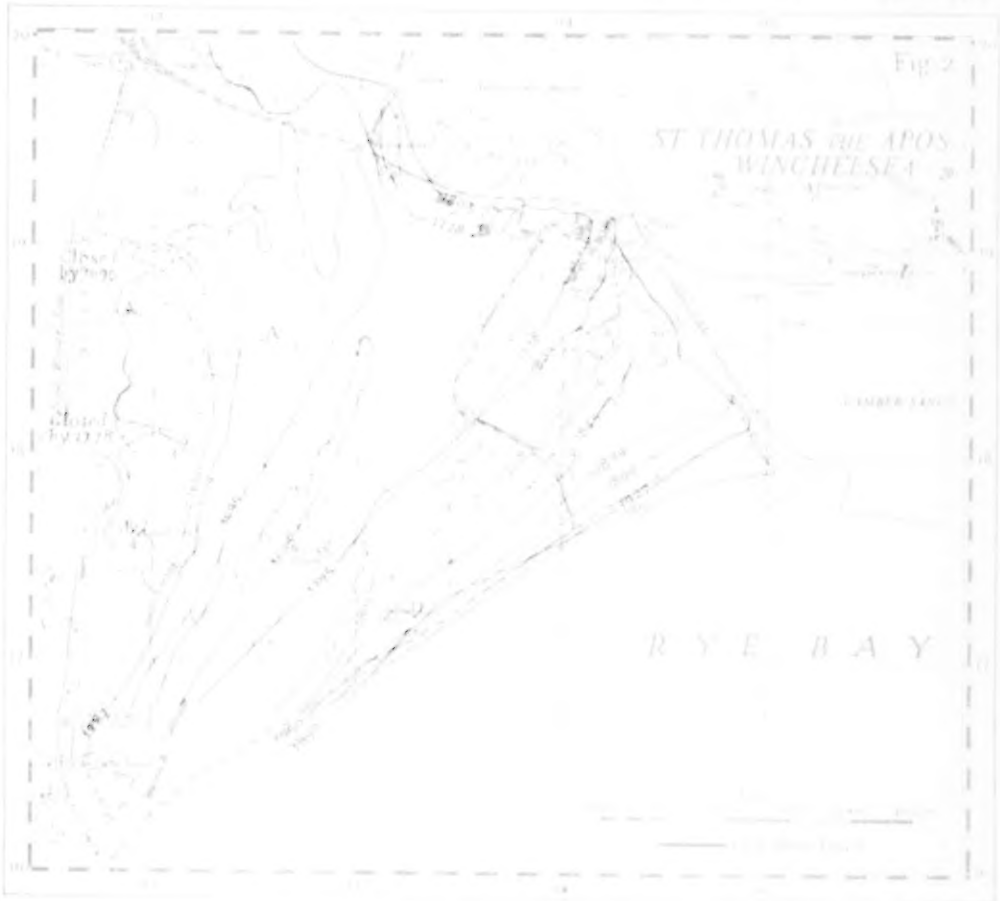
The third series is separated from the second by a narrow strip of marsh. It consists of those naked fulls marked on the map directly east of the Castle, together with clothed extensions to south and north. It does not stem from the sand plateau, but, as shown in Figure 1, tends to coalesce with the younger Nook Beach series, whose fulls seem to overlay some of its roots. The fulls of the third series are high, widely spaced and contain large areas at their northern ends, where sand predominates over the shingle.

Figure 2 shows certain lines of levelling. The position of these lines was chosen for me by W. V. Lewis to cover the important fulls of the above three series and to relate them to the more recent shingle to seaward. The actual levelling was carried out for me by the staff of the Rother and Jury's Gut Catchment Board through the kindness of C. H. Dobbie, the Board's engineer. In section CD (Fig. 3) it will be noticed that the height of the ridges decreases from D, the Lifeboat House, to about the 5000-foot point. This is because the ridges are here curving landward and losing height as they do so. In the same section there is a distinct drop in average height of ridges from the Watch House to Point C. Inspection on the site shows no reason for this and it is tempting to suggest that this represents a true lowering of the sea-level in the seventeenth and eighteenth centuries. It is understood that this decrease in height is consistent with some of the levels taken by W. V. Lewis on the eastward facing ridges of Dungeness.

In Section BC the height of the ridges at B, Castle Farm, is surprising since they here face north to north-east, a fairly sheltered quarter. Their height might suggest a change of sea-level but it might also be accounted for by abnormal storms. In Section AA′ the decrease in ridge height towards the western or landward end is accounted for by the landward swing of the ridges which decrease in height as they curve westward.

The old sea wall mentioned above is the innermost of all the old sea defences in the area. Between it and Winchelsea hill is all good marsh land and it is therefore probably the truncated remnant of the last sea defence before the cessation of an erosion cycle. A general inspection indicates that at the present northern end of the wall, a very wide breach in the defence has at one time occurred and has been healed gradually by the deposition of

NEAR CAMBER CASTLE



sand and shingle in the form of a fan of raised beaches based on the southern end of the breach, *i.e.* the sand plateau already mentioned. Thereafter the deposition has continued, fanning out from a point at the southern end of the wall near the Old Ship Inn. Several of these last depositions can be dated by reference to old maps and charts, but for light on the breach and the sea wall we must turn to the history of the town of Winchelsea.

Until the second half of the thirteenth century it seems fairly certain that a continuous spit, presumably of sand and shingle, protected the marshes between Fairlight Cliffs and the Dungeness shingle.[3] To landward of this spit the rivers Brede and Tillingham flowed eastward amongst their own marshes to an outlet just west of the Midrips.[4] Despite a detailed definition, in 1330, of the boundaries of the Liberty of Winchelsea, which then included most of the above foreshore,[5] the exact alignment of the shore line of this period is by no means agreed. Homan suggests [6] that Old Winchelsea lay at the eastern end of this spit which was here some distance to seaward of the present shore line. He also argues that the western end of the spit was protected by the old sea wall and that this was named Daunswall or Daneswall. I can add one further point which may help confirmation of the latter. Old Winchelsea suffered catastrophe in the late thirteenth century. In 1302 a Commission, ordered to examine the sea defences in the area of New Winchelsea, remarked in some perturbation that if the marshes to the east of the town were to be saved it would be necessary to renew or repair the old sea wall [7] (in later Commissions named the Daneswall) for a length of 350 perches—1925 yards.[8] Now the Winchelsea marshes are divided from the main part of Pett Level to the southward by an old embankment running eastward from the south end of Winchelsea hill to meet the old sea defence under discussion a short distance from its present southern end. We may assume that it was that portion of the Daneswall which guarded the Winchelsea marshes that gave the Commissions so much concern in the early fourteenth century. The length of that portion of the old sea defence from where it passes the east/west embankment to where its northern end disappears in the sand plateau east of Castle Farm, is 1930 yards. All things considered I therefore suggest that the old sea defence which still runs from near Castle Farm to the Old Ship Inn is identical with the historical Daneswall.

Thus if the thirteenth century shore line ran along the Daneswall (north-north-eastward) and changed to eastward as it approached the Dungeness shingle,[9] there must have been a very marked curve between these two sections. This curve would probably have been more than ordinarily susceptible to sea erosion, and that erosion was certainly in progress during the thirteenth century is shown by the history of old Winchelsea.[10] Anxiety about the old town was first expressed in 1236 after which there are frequent reports of steady demolition by the sea until, in 1276, the King in person visited the town to consider measures for its transfer to a new site. The new town was built and the transfer of the inhabitants effected in 1292 but not before Old Winchelsea had suffered, in a storm in 1287, such devastation that it was said to have been drowned and destroyed.[11] In fact the town was not entirely destroyed for it is mentioned again in 1292 [12] and the port light, a Hermitage of the Hospitalers of St. Antony, was still standing well into the

fifteenth century.[13] But such an apparent over-statement must surely have been caused by some extraordinary occurrence. The clue may be found in Camden's remark, quoted by Holloway,[14] that, at the same time as Winchelsea was destroyed, the sea "removed the Rother out of its channel,"—then near New Romney—"stopping up its mouth, and opening for it a nearer passage into the sea by Rye."

An explanation which might satisfy these statements and be true to the evidence on the ground is that, during the great storm of 1287, the curved and very vulnerable sea defences from the present northern end of the Daneswall at least as far as the present course of the Rother were finally overwhelmed. The breach thus caused was far too broad for any hope of repair and Old Winchelsea found itself suddenly and permanently upon an island. Already half washed away on its seaboard side it was now cut off from communication with the mainland except by boat, and the strip of land left to it amongst the waste of waters was rapidly diminishing. In these circumstances it would be only natural for the inhabitants to speak of their town as destroyed. It is therefore suggested that the breach northward of the Daneswall occurred in 1287 and this date is therefore the earliest shore line amongst the shingle ridges in this area.

Outboard of the covered fulls near Camber Castle, the shingle has been laid down in a fan springing from the Old Ship Inn,[15] whose "sticks" are the fulls of beach, the interstices being filled by narrow strips of marsh. There are two main interstices, the Nook and an inner strip on which stand some disused rifle butts. The Nook has been caused by the outfall from the New Harbour.[16] This abortive attempt to improve the prospects of Rye was undertaken during the eighteenth century and, being opened in 1766, was finally abandoned in 1787.[17] Thereafter a shingle spit overlapped the entrance and extended north-eastward, leaving between itself and the old shore line a narrow channel, named delightfully "Greedy Guts", which was kept clear of shingle by the scour of the tide that still had access to a mile or more of the New Cut, as the seaward end of the artificial channel was named. Greedy Guts was later reclaimed and became the Nook. The Rifle Butts strip of marsh was laid down in the late seventeenth century but I can find no hint, either in records or on the ground, which will account for it.

Dated shore lines

I have not attempted to take the shore lines south of the line which is the bottom of the Ord. Survey Six-inch Edn., Map No. 45 S.E. Figure 2 shows the major part of the area and, to the southward of its limits, the shore lines get so close to each other that the older maps cannot provide a reliable picture. Furthermore, although the shore line between the Old Ship and Fairlight Cliffs has undoubtedly eroded[18] man has fought back so fiercely in defence of the Pett Levels that the sea's gain has been only a matter of yards.

Mapping or charting of the area began in the mid-sixteenth century and has been fairly continuous since that date. But not all the maps and charts are of equal value, and I have had to select my shore lines not only to give a fairly representative selection but from amongst those plans which seem to show careful and accurate representations of the coast. As an instance,

Symonson's map of 1594 is a wonderful thing. When I had finally drawn in my fulls on the twenty-five-inch maps and began to consider them I saw his outer shore lines fairly standing out amongst them, curve by curve, promontory by promontory. I selected Symonson therefore instead of Stonham (1599) who is concerned principally with the villages and water-lets on the marsh and whose shore line is the merest sketch with no pretence to accuracy. Again for the late seventeenth century I have had to go to an unnamed map because of its accurate shore line when compared with its contemporaries. My main sorrow is that Poker's magnificent map of the Marshes in the early seventeenth century does not cover my area.

Shore line of 1287

As I have already stated, this is the date of the break in the sea defences and I have drawn the shore line on the first of the fulls between Castle Farm and the Daneswall. From here I have drawn it following the wall because, on the evidence of Commissions, the wall was reached periodically by high tides, though whether daily or only at springs it is impossible to say. This is the only shore line which is not drawn from a map or chart. It must therefore be regarded as tentative, though I believe there are good reasons for it.

Shore line of mid-sixteenth century

The plan from which this shore line[19] was taken was attached to a petition dated 1571, but I have elsewhere given reasons[20] for believing that it is itself some thirty years earlier than that date. Prowez, who was probably the Master Gunner of Rye, was a good draughtsman but his shore line is only roughly shown and mine must therefore be regarded as tentative. The Castle is however a good guide[21] and I think that the full I have selected is probably the right one.

Shore line of 1594

There are few difficulties here.[22] The fulls fit in very accurately with the shore line shown on Philip Symonson's map of the district.

Shore line of 1695

The plan used for this shore line[23] is undated and unsigned. Vidler places it at about 1700. It corresponds fairly closely with Greenvile Collins's chart of 1693 but depth of water in certain places is less. When compared with Newman and Hill's Plan of 1700, the latter shows certain innings which do not appear in the plan in Vidler's book. I therefore incline to give the date 1695 to the latter. I have chosen it rather than any other plan of this period for the care which has been bestowed on its shore line and I am of course well placed to check this fact. All the old shore lines are before me; it is merely a matter of comparing the old chart with ground evidence. By 1695 there were many saltings in the area. The shore line is thus that of the spring tides. To seaward of this line were considerable acreages covered only at springs. The 1695 shore line exhibits an increased rate of deposition in the seventeenth century.

Shore line of 1778

I have chosen Yeakell and Gardner's rather than Smeaton's better known map of fifteen years earlier both because it has land detail, which Smeaton lacks, and because Smeaton's shore line is in a very fluid condition. He shows a great excrescence, "a body or full of beach that seems to be driving down from the westward and which will probably form a fresh point on the west of the Old Harbour's mouth." I do not know whether the Eastward Drift has often taken this curious form. Smeaton infers that it has occurred before but his is the only plan I know which shows it in operation. By 1778, at any rate, this "body or full of beach" had arrived against the Rother. The New Harbour works, to which reference has already been made, were begun in the mid-eighteenth century and it is apparent that the shore line for 1778 had been protected for some years from further accretion.[24]

Shore line of 1803

As the New Harbour was abandoned, the spit outside Greedy Guts Harbour has made to the eastward and is now visible enclosing a portion of what is later to become the Nook. The old shore line within it has been largely sheltered and has not advanced from its 1778 position until quite near the Rother Mouth. The shore line along the Rother itself marks the river edge of the saltings. Within thirty years or less of this date the last river embankments were built on either side of the Rother which was constrained thereafter in its present bed.[25]

Shore lines of 1845, 1874, 1899 *and* 1927

This series[26] shows the trend of the shore lines at about quarter-century intervals during the past hundred years. The Nook had been "inned" by 1845 and therefore the shore line advances southward fairly steadily.

Shore line of 1950

The difference in trend between this shore line[27] and its immediate predecessors seems to be due largely to man's handiwork. Some years ago a wooden screen, parallel to and a few yards seaward of High Water, was constructed from Cliff End as far east as the Life Boat House. This was built in conjunction with a series of wooden groins, set roughly at right angles to the shore, which continued beyond the eastern end of the screen towards Rother Mouth. A more recent addition to the local beach works is a high steel and concrete groin or shutter built out from the western point of the Harbour Mouth. It is against this work that the shingle is now piling to cause the southward hook in the shore line.

The latest shore work in defence of Pett Level is a sea wall which, starting at Cliff End, has so far been extended to a little east of Dog's Hill. Whether or not this will affect the shore line under notice in this article is not yet apparent.

This survey of mine has been a considerable effort for a mere amateur with no qualifications except residence in Winchelsea and a fondness for old charts. I could not have completed it without considerable encouragement and assistance. My thanks are due first to Vice-Admiral Sir Guy N. Wyatt,

who, as Hydrographer of the Navy in 1947–48, permitted me to examine to my heart's content any and all the old charts and original surveys of the district in the possession of his Department. I should like also to thank W. V. Lewis, of Cambridge, whose 'Past sea-levels at Dungeness' set me on the road and whose advice and assistance has always been available to me for the asking. I am also greatly indebted to C. H. Dobbie, late engineer to the Rother and Jury's Gut Catchment Board, who has organized such levelling as I required. Finally, my great thanks to W. MacL. Homan, of Winchelsea to whose unfailing help and kindness is due any knowledge I possess of the town and district he loves so well.

REFERENCES

[1] *Geogr. J.* 96 (1940) 2.

[2] Ord. Survey Six-inch Series. No. 49 north-west where the Inn is marked "Ship (P.H.)." The ruins of this inn finally disappeared in 1950 under the advance of the new sea wall constructed for the protection of Pett Level.

[3] *Sussex Arch. Collections*, 79 (1938), W. MacL. Homan, "The Marshes between Hythe and Pett." This is, I believe, the latest paper published on the subject. Such a spit, forcing eastward the mouth of a small river, is a very probable formation which can be seen to-day at, for example, Shoreham. See also, Steers, 'Coastline of England and Wales,' for other examples.

[4] To the east of the river Rother, the old course of the Brede can be traced on maps of the sixteenth century and later, and can be traced on site to-day. It runs just north of Camber village and the remains of the old outlet, now a series of rush-filled pools and meres, lies between that village and Broomhill Farm. See Ord. Survey, Six-inch Edn., No. 46. South-west and south-east in Graeme Spence's survey of 1803 and charts of that time, the sea defences covering the end of this outlet are named "Siege Gap"—*i.e.* the spot where the defences were to be broken to flood the marsh in the event of a French invasion.

[5] Homan, *ibid.* p. 220.

[6] *Ibid.*

[7] See various reports of old Commissions in 'The history of Winchelsea,' Cooper, 1850, and 'The history of Romney Marsh,' Holloway, 1849.

[8] Allowing $5\frac{1}{2}$ yards to the perch. Although the length of the perch may have varied slightly through the centuries, I am indebted to Mr. Homan for the information that the measure used in laying out New Winchelsea in 1280–92 was apparently a rod or pole of a shade under 16 feet 6 inches, or just about $5\frac{1}{2}$ yards. It seems reasonable to suppose that a similar measure might have been used ten years later on the adjacent marsh.

[9] See Homan, *ibid.* Map, p. 200.

[10] Homan, *ibid.* p. 215, and Cooper, *ibid.* pp. 13–22.

[11] Cooper, *ibid.* pp. 20–1.

[12] Cooper, *ibid.* p. 22.

[13] Homan, *ibid*, p. 219. Appendix D.

[14] Holloway, *ibid.* p. 77. See also Cooper, *ibid.* p. 21.

[15] In this article this name refers always to the old Public House marked on the shore in Ord. Survey Six-inch Edn. No. 49, north-east. A new "Old Ship" Inn has been built within recent years not far from "Harbour Farm" on the same map.

[16] Ord. Survey Edn. of 1815, Sheet No. IV, and Admiralty Chart No. 7. Dover to Winchelsea, published 1809.

[17] The best accounts of the construction of this harbour are given in Meryon 'Harbour of Rye' (1845) and Vidler, 'A new history of Rye' (1934).

[18] There was a line of Martello Towers here, built in the early nineteenth century, of which the last disappeared in 1904. See *Mariners' Mirror*, 34 (1948) 4; Mead, "The Martello Towers of England.' These towers were not shown on the Ordnance maps of the period but were given in the Admiralty charts.

[19] Plan of Winchelsea and Rye Harbour. Signed by John Prowez. Original in Public Record Office, No. M.P.8, 212.

[20] *Mariners' Mirror*, 33 (1947) 3. Lovegrove. Shipping in a sixteenth century plan of Winchelsea and Rye. Mr. Homan, who surveyed Camber Castle for the Victoria County History and has given it a good deal of study, has suggested to me that the original purpose of this plan may have been to propose a position for

the Castle and to indicate a source for its material—the town walls of Winchelsea which disappeared without trace during the sixteenth century. The castle was built in 1538–9.

[21] Cooper, *ibid.* p. 176, quoting Holloway, "the sea at this time (1540) flowed very close to the walls of this castle on the south-east and north sides and, having passed the latter, it formed a large bay running back to the westward as far as Winchelsea."

[22] This map was on loan to Rye Museum before the Second World War. I understand that a reproduction of it was given in the *Daily Express* on 23 August 1935, and that it was unknown until shortly before that date. I do not know its present whereabouts. The details for this shore line are taken from a photostat copy in my possession.

[23] From an illustration in 'A new history of Rye,' by L. A. Vidler (1934).

[24] From Yeakell and Gardner's map of this date. Photostat in my possession.

[25] A chart of Rye Bay and Hithe Bay. Graeme Spence, 1803. Original in possession of Admiralty. Also Admiralty Chart No. 7, Dover to Winchelsea 1809.

[26] 1845, Admiralty Chart No. 7, 1845 Edn.; 1874, Admiralty Chart No. A.4146, 1874 Edn.; 1899, Ord. Survey Six-inch Second Edition, 1899; 1927, Ord. Survey. Provisional Edition.

[27] From a mosaic of air photographs in the possession of the Nature Conservancy, 91, Victoria Street, London, S.W.1. A tracing of the shore line was very kindly sent to me, but I am informed that it is only approximate, due to the difficulty of determining its exact position from the mosaic.

MR. HAKLUYT, SCHOLAR AT OXFORD

TOM GIRTIN

IT HAS LONG been known from the few available facts of his early life that Richard Hakluyt, the preacher, was a scholar of Christ Church, Oxford. That he held a studentship there from Westminster School, that he also received a very small supplement to this studentship from the Nowell educational bequest and that, in the normal course of events, he proceeded to Master of Arts in 1577 are facts sufficiently known to need no more than recapitulation. It has been known, too, though it is not recorded by Parks,[1] that he received from the Skinners' Company, of which his father was a member, an exhibition of £2 13*s* 4*d* a year.

Now, almost exactly 400 years after his birth, there emerge one or two new facts to add to the scraps of knowledge that provide the only direct information about his early, formative days. On 13 August 1577 a meeting of the Court of the Clothworkers' Company was held in their Hall in Mincing Lane:

> "In the presence of Mr. Marwood, Master of the Company; Master Gilborne, Mr. Southall, Mr. Hewett and Mr. Herne, Wardens; Mr. Dycher, Mr. Pettinger, Mr. Clarke, Mr. Lister, Mr. Howse, Mr. Parkinson, Mr. Hardinge, Mr. Sleiford, Mr. Lacye, Mr. Mellowe, Mr. Tailforde."

Among other business transacted

> "This daie also was grannted to Richard Hackluytt, being a scoller in Cristechurche in Oxforde who, as he saith, is alredie p'ceded maister of Arts and is entered into the studie of divinitie, Upon the condic̃on that he p'ceded maister of Arts as aforesaid and do studie divinitie and so continue the same studie the next avoidannce of the penc̃on of vj^{li}xiij^{s} iiij^{d} by yere grannted by this Companie to Mr. Wilson, Scoller and which he now enioyeth when the same shalbecome voide by death Resignac̃on or otherwise. He to enioye the same duringe the Companies pleasure."

From this entry it could be deduced that he did not take up the study of Divinity until the year 1577; what is quite certain is that Richard Hakluyt at the age of twenty-five was extremely hard up. The Nowell educational bequest was for needy scholars. The Clothworkers' Exhibition was for poor students only and, in fact, it had been proposed that the grant be taken away from Mr. Wilson for the reason that the Company were informed

> "that he was very well otherwise preferred and that he needed not the same exhibition"

In a state of great agitation, Wilson rushed up to London from Oxford. He pleaded with the Court of the Company, he disclosed his whole circumstances, he listed his expenses: as a result the Company, convinced of his poverty, renewed his grant for another two years.

[1] George Bruner Parks, 'Richard Hakluyt and the English voyages,' *Amer. Geogr. Soc.* Special Publication 10 (1928).

In the normal way Hakluyt would have had to wait for those two years. It is clear, however, that he had a friend or friends at Court. For, while Mr. Wilson continued to receive his Exhibition, Richard Hakluyt, in less than one year, began to receive a similar Exhibition. The first payment was made, evidently at Midsummer in 1578, out of the Renter Warden's account.

> "*Item:* paid to Richard Hakluyt, scholar of Oxford, of the benevolence of this house towards his exhibition and is payable quarterly.... 6.13.4."

It may therefore be inferred that Hakluyt's father was not so well off as has been suggested, and that "all his four sons could afford a University education" is perhaps an overstatement. At most it can be said that by dint of support from Westminster School, from the Skinners' Company, from the Nowell bequest, and now, lastly, from the Clothworkers' Company the second son was enabled to remain in residence.

The way in which Richard Hakluyt came to be connected with the Clothworkers must remain a matter for speculation. Of those members actually present at the Court meeting referred to above, the name of Mr. Pettinger is the only one that springs to the eye as having a known connection with the name of Hakluyt. Petynger or Petyngar was an old Clothworker name and it was in company of a Spero Pettingarre that, in 1605, Richard Hakluyt dined, innocently enough, at the Mitre Tavern in Bread Street with some of the Gunpowder Conspirators before going on to Pettingarre's rooms "to peruse a rutter of Sir Francis Drake's works of navigation." Whether Hakluyt became friendly with the Pettinger family before or after his association with the Clothworkers' Company may never be discovered—a remark that applies to his friendship with both Alderman Richard Staper and Sir Edward Osborne. But whatever his original connection with the Company may have been, by Midsummer 1578 he was enjoying the benevolence of their house.

Now, when Hakluyt writes in the "Voyages" of how "my exercises of duty at (Christchurch) first performed I fell to my intended course" it is possible that he refers not, as has been suggested, to his "seven years' study of the humanities" but to his duties to the Clothworkers' Company. Certainly it cannot be an entirely true supposition that, after 1579, "he then avoided the divinity schools and fell to his intended course in languages and science." For the Clothworker Exhibition was payable only so long as he continued to study Divinity and in 1580 he was certainly still tutoring in Divinity for, on May 10 of that year, the Clothworkers' Company awarded an Exhibition at Magdalen College, Oxford to one Gabriel Bowman to study Divinity "And Mr. Hakluyt to be his Tutor if it may be."

It has previously been impossible to fix the date of Hakluyt's ordination more nearly than "some time between 1577 and 1583." This gap may now be halved, for the Clothworker Account books indicate that he had been ordained earlier than 1 August 1580, the Election Day of the Company.

> "*Item:* paid to Mr. Hakluyt our Scholar for charges of coming from Oxford and going back again to make a sermon for the Company on the Election Day . . . 13.4."

That the Sermon was sufficiently well liked is evident from the fact that Hakluyt was chosen to preach the Lambe Sermon on Lady Day 1581.[1] William Lambe—a great benefactor of the Clothworkers' Company—had left, among many other larger bequests, provision on four days of the year for "some godly learned man" to make a Sermon to be preached at Lambe's Chapel in Monkwell Street, the Church of St. James-in-the-Wall. On 25 March 1581 the godly learned man was Richard Hakluyt: on this occasion "for his charges up and down from Oxford . . . . . over and besides his stipend of 6/8 for the said sermon" he received £1 6*s* 8*d*.

There is little more to be said of his studies in Divinity: they evidently continued, for a further mark of the Clothworkers' rather wary esteem was accorded him later in 1581 when, on September 12, it was

> "ordered and agreed that Mr. Hakluyt our Scholar at Oxford shall have our books of Saint Augustine's Works out of this house for the furtherance of his study he putting in sufficient sureties for the safe delivery of the same again upon demand."

The books—eleven volumes in all—were evidently safely returned for, nearly 200 years later, during a Spring-cleaning of the cupboards at Clothworkers' Hall, they were brought to light and presented to the Library of Sutton Valence School where they still remain.

During this time Hakluyt, in his own phrase, "grew familiarly acquainted with . . the greatest Mercants . . . of our nation." Parks has suggested that "that he was his father's son may have helped him to relations with the City."[2] His connection with the Clothworkers' Company must certainly have helped him even more. Richard Staper, Master of the Company in 1590, was a main promoter of the Levant Company and it was he who furnished Hakluyt "with divers things touching the Trade of Turkey and other places." In 1599, too, Hakluyt in the Epistle Dedicatory to Sir Robert Cecil talks of

> "the happy renewing and much increasing of our interrupted trade in all the Levant, accomplished by the great charges and special industry of the worshipfull and worthy Citizens Sir Edward Osborne, Knight, and Mr. Richard Staper . . ."

Osborne was as much a leading figure in the Clothworkers' Company as was Staper, and a glance at the list of "adventurers" in any of the Trading Companies—the Virginia Company, the Levant, the East India, the Merchant Adventurers—will always reveal the names of prominent Clothworkers amongst them. Not only was Hakluyt right in the main stream of mercantile thought but the Clothworkers were also in touch with people of influence whom he had already met elsewhere through other channels. Sir Francis Walsingham, whom he had met through his college contemporary Philip Sidney, was a tenant of the Company; the Earl of Cumberland, whom he had

[1] As Dr. J. A. Williamson has pointed out in 'Richard Hakluyt and his successors' (The Hakluyt Society, Series 2, vol. 93, 1946), Hakluyt had early described himself as "preacher": hitherto there has been little, if any, evidence of this occupation.

[2] Parks, *op. cit.*

probably met at Oxford, became, as the previous Earl had been, a Freeman. Even with the Throne there were additional connections, for Mr. Lacy—one of the Court present on the day that Hakluyt was granted his Exhibition—was on terms of friendship with Queen Elizabeth. In this milieu Hakluyt must readily have found the "access to the merchants' records" on which Parks, particularly in connection with the narratives of the Levant, comments.

It looked, in 1582, as if Richard Hakluyt's Clothworker Exhibition was coming to an end. A successor to him was being freely discussed. On April 26 one Berdemore (his Christian name is not stated) came to the Court of the Clothworkers' from Oxford and was granted

> "the pension of £6.13.0. (sic) now paid to Mr. Hakluyt saving to all their other grants"

This, coupled with the fact that Hakluyt now took up an overseas appointment that ended his residence at Oxford, might well have been the end of his official connection with the Clothworkers' Company. But it was not so and of all the new trains of thought started by the discovery of Hakluyt's name in the Clothworker archives perhaps the most provocative arises from the entry dated 3 September 1583:

> "This day at the request of the Right Honourable the Lord Treasurer of England, signified by his letters, it is ordered and agreed that Mr. Hakluyt the Company's scholar, who is appointed to go with the Lord Ambassador into France, shall have his pension of £6.13.4. yearly paid to him during his abode there in the service of the said Lord Ambassador. And that Mr. Warden Brand shall pay to him presently his quarter's pension due at Michaelmas next. And so from thenceforth quarterly as it shall be demanded."

It was demanded for another three and a half years and for all that time Hakluyt was still referred to as a scholar at Oxford. During those years, as chaplain to Sir Edward Stafford, Hakluyt, as Parks has described, busily gleaned every kind of geographical, mercantile and statistical piece of information that he could discover in the listening-post that was France. At the same time he was coming and going between France and England acting as courier and carrying confidential letters (and, on one occasion at least, a highly secret message) and information. In these messages from Stafford to Burleigh, Stafford speaks as if he was unaware that Burleigh knew Hakluyt: "I know this bearer is faithful and will deliver this into your hands", and "I have taken his oath upon a book for secrecy; for his honesty I will answer." Parks has commented that "it is in its way startling that Hakluyt should ever have embarked on the mission, should ever have broached the idea of making a colonial *dossier*. The initiative I think we may assign to Hakluyt himself. He probably went to France because he wished to, not because he was sent." But Parks was writing[1] without the knowledge of Burleigh's intervention in the affairs of Richard Hakluyt.

Is it possible that Burleigh was engaged upon some intrigue of his own, that Hakluyt was a commercial spy whom the Lord Treasurer wished to be

[1] *Ibid.*

paid in a manner at once unobtrusive by nature of its continuity and unrecorded in the Treasury accounts? Whatever may have been the reason that led Lord Burleigh to interest himself on behalf of a minor official on the staff of the Ambassador to France, the Clothworker payments came to an end on Lady Day 1587 when, by mutual consent, the pension became voided. From thenceforward, except for a few quarrels over the question of who should succeed to the reversion of the Exhibition, nothing more is heard in the Clothworker archives of "Mr. Hakluyt, our Scholar at Oxford."

TECTONIC RELIEF: WITH ILLUSTRATIONS FROM NEW ZEALAND

C. A. COTTON

TECTONIC RELIEF is something quite distinct from structural relief, which in the accepted usage of geomorphology is a product of erosional sculpture that has become adjusted to the structure of the region. Structural escarpments, whether at the outcrops of horizontal or inclined strata, are among its most conspicuous features, but structural relief includes the hogbacks, homoclinal ridges, and cuestas as a whole which mark the outcrops of hard or resistant formations, with also the vales and narrower subsequent valleys picked out by long-continued denudation and river corrasion along the belts in which weaker strata outcrop.

Structure, in the geological sense, is the arrangement and pattern of folding and faulting as these affect stratified formations in particular, with also the pattern and interrelation of intrusive rock masses and the terrains which they invade; and structure is geomorphically significant when it brings weak and resistant formations into juxtaposition, so that erosion, faster on some and slower on others, is able to emphasize differences and so to shape both major and minor landforms. The forms of structural relief being entirely of erosional development, one must distinguish with care between structure and tectonics. Tectonics, *i.e.* the earth movements of folding and faulting which have produced the pronounced structural patterns found in many landscapes, may be those of some long-past geological epoch. Long ago the relief—potentially a fantastic relief in many cases—produced by those ancient tectonics has been destroyed, for cycle after cycle, each of vast duration, may have run its course before that one started in which modern erosion has discovered and revealed the areas and belts of weaker rock, and the landscape pattern has been developed so that commonly it displays a mature relief. Purely erosional relief is familiar to British geographers, and those accustomed to the sight of the subdued landforms of this country are apt to assume that all terrestrial relief must be of similar erosional development.

Tectonic relief, on the other hand, has itself resulted primarily from earth movements; and these have taken place very recently. The major relief of peninsular Italy, for example, is of such origin. Given time, erosion will destroy it; and for this destruction only a moderate allowance of geological time is required.

Compared with the intense deformations of the past, as revealed by geological evidence, those which have produced the tectonic relief existing to-day are comparatively mild: from a geological point of view, indeed, they may be thought negligible as compared with the Alpine paroxysm of orogeny which looms up in the background. But it must not be forgotten that the latter occurred millions of years ago and has been followed by an almost inconceivable amount of erosion. Milder and more modern orogenies have, moreover, been restricted to definite regions—to parts only of the mobile belts affected by Alpine orogeny. But the mobile belts as a whole occupy quite a large share of the earth's surface, and considerable parts of them are still, or have been recently, writhing.

There are large regions in which, though earth movement has occurred rather recently, this has scarcely anywhere dislocated the land surface or even caused

any obvious tilting of it, though it may have been strongly upheaved and depressed as very broad domes and basins, so that the pre-existing erosional features on the domed areas have been rejuvenated, while the downwarped basin floors have been aggraded, becoming basin plains. Great rivers cut through the ranges of mountains made by such uplift in antecedent gorges, and some less vigorous rivers may have been ponded and diverted. In association with the well-known features of rejuvenation in such regions some minor tectonic scarps may locally appear. But conspicuous features, especially scarps, of tectonic relief are more especially characteristic of the belts in which orogeny rather than epeirogenic movement is in progress. This is a case involving much stronger warping, or folding, of the land surface and is generally accompanied by some, perhaps much, faulting, which develops the strong slopes of a tectonic relief.

In some regions erosional relief, though invariably present, is, so to speak, of secondary importance, for all major landscape features (excluding volcanoes, if there are any) are tectonic. Such an area may be characterized by the presence of more or less clearly defined block mountains, if this description be reserved for relatively uplifted or uptilted crustal blocks with distinct, or at least still recognizable, major fault scarp boundaries on one or more sides.

In addition there are, however, many examples of upheaval in which *primary* warping or *folding* of the already existing land surface has taken place, whether that surface be erosional or depositional. In New Zealand and in some other parts of the mobile belts, major relief features are recognizable which are recently uprisen; and in certain cases still growing anticlines and "folding" must be redefined in conformity with this concept, whether or not it is obvious that the movement in question has folded actual strata that previously lay more or less horizontally. Complementary to the anticlines of such recent orogeny there are synclinal hollows which, naturally, in many cases guide main rivers in consequent courses, though some rivers break through the ranges in antecedent gorges.

Scarps abound on the flanks of major and also minor anticlines and valley furrows of such recent development; but the steeper and more prominent these have been initially (or are potentially if of slow growth and currently eroded), the more they have been subject to degradation by erosion. Thus many scarps so formed are now in such a "faded" condition, or are so nearly obliterated, that they are easily overlooked. The development of criteria for the recognition of tectonic scarps even when the process of decay is far advanced towards their destruction is a matter of great importance, however, because of the light which such recognition throws on the history of a landscape.[1]

Scarps

Scarps may be distinguished as tectonic or erosional, the latter group including, besides structural escarpments, those developed by erosion along the lines of ancient faults. But not all "fault-line" scarps are to be excluded from the tectonic category. Where circumstances have been favourable—and this is a condition often found—erosion can quickly degrade and obliterate a scarp produced initially by faulting while at the same time developing a new scarp immediately beneath it on the same fault; and this, though technically a fault-line scarp, is recognizable as a feature of the tectonic relief, provided that the

[1] This subject has been treated in a communication to the Geological Society of America (C. A. Cotton, "Tectonic scarps and fault valleys," *Bull. Geol. Soc. Am.* 61 (1950) 717–58).

fault so emphasized is one that has been developed in the genesis of the ensemble of landscape forms with which it is associated.

The best known examples of tectonic scarps definitely aligned on faults are in semi-arid regions, a circumstance that has immunized the scarps from attack by vigorous consequent rivers such as, it might be deduced, should commonly flow along fault scarp bases in humid regions. Numerous fault scarps which descend to river valleys and thus have undergone more thorough (and earlier) dissection are known in New Zealand; and these have been distinguished from the former (Basin Range type) scarps as the Awatere type [1] (Fig. 1).

Fault scarps grade into monoclinal scarps that are also tectonic (Fig. 2). After reaching a certain stage quite early in their degradation tectonic scarps of these two kinds tend to become indistinguishable one from another if, as is frequently the case, the verdict of subsurface geology on the fault or monocline in question is inconclusive. But, though the structure beneath the tectonic scarp may remain to this extent in doubt, its diagnosis as a tectonic feature is of prime importance in the interpretation of the landscape and its history.

Fault valleys

Among the most striking features of tectonic relief are fault-made, as distinguished from erosional "fault-line," valleys. Not all of these are conspicuously major tectonic furrows or fault angles (*cf.* Fig. 3), such as are found commonly in regions of range-and-basin tectonic relief. Fault-made valleys are not necessarily continuous in the sense of being followed throughout their length by single consequent streams. There may be seen no more than an alignment of reaches, perhaps of several different rivers, linked by conspicuous V-shaped notches through the intervening hills; but some such features in New Zealand are strictly rectilinear for long distances and are aligned on suspected or known faults, some of the latter marked by scarplets which indicate a recent renewal of faulting. Only tentative explanations of their origin can yet be offered. Some of them are perhaps related to transcurrent movement still intermittently in progress, evidence for which has been obtained by the investigators of major faults in New Zealand.

Others, however, may be bounded initially on both sides by fault scarps [2]—not necessarily the lateral walls of a narrow graben, but rather scarps that face each other because of a reversal of the sense of dip-slip displacement on a single fault. Such reversal on ancient faults is well known from geological data, and "reverse" scarplets which break the land surface in New Zealand have been explained as the result of fault movement in reverse. This, if followed by continued movement in the new sense, would certainly make some tectonic valleys.

New Zealand furnishes examples of range-and-basin landscapes varying from more or less typical fault-block mountain relief to a characteristic pattern of major anticlinal and synclinal—or elongated dome and basin—features more or less broken by faults. The development of a large scale mosaic of this nature in the southern part of the South Island, together with the geological terrain—an undermass of schist and greywacke truncated by a planed surface which, when stripped by erosion, emerges from under a widespread weak cover—has resulted in a display of long-enduring tectonic features of the magnitude of mountain ranges and large intermont valleys. These survive particularly well in non-glaciated districts, but are recognizable also where, farther west, they have been modified by the work of ice. Major tectonic forms remain distinct in this

[1] Pron. *A'-wa-te-re*; *loc. cit.* 726.

[2] C. A. Cotton, "Revival of major faulting in New Zealand," *Geol. Mag.* 84 (1947) 79–86.

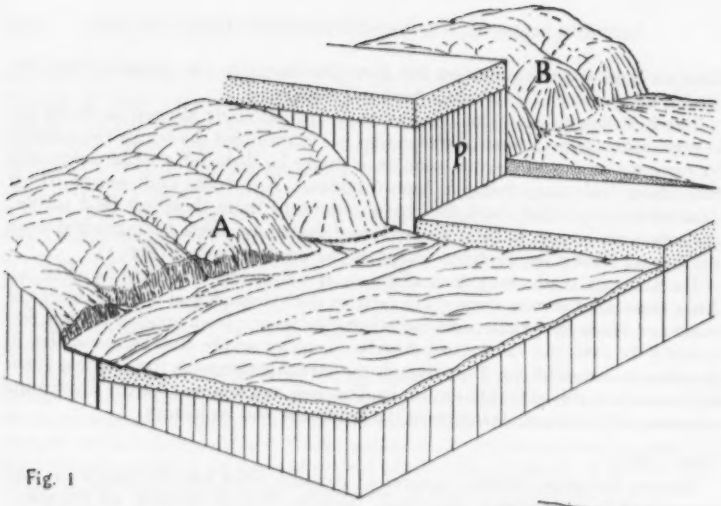


Fig. 1

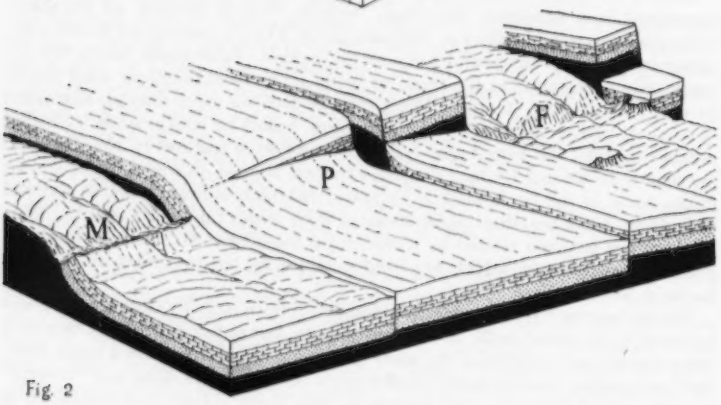


Fig. 2

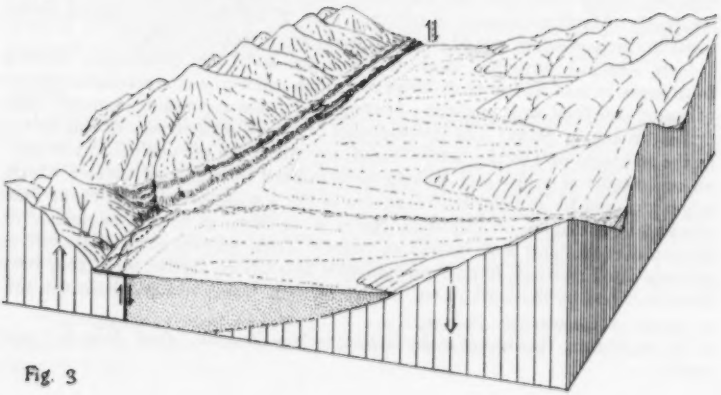


Fig. 3

region despite the cessation (at an indeterminate date) of the orogenic deformation that produced them. Of this there is evidence in the absence of seismicity to-day.

A complete lack of seismicity from the northern peninsula of the North Island also is consistent with other evidence of an early ending of active movement there. This is confirmed by an advanced maturity of landscape form, which suggests indeed that the period of quiescence has been of longer duration than in the far south. Even in the northern peninsula, however, the major features are recognizably tectonic; but their freshness has faded.

In the central seismic belt, which includes Cook Strait and occupies considerable parts of both North and South Islands on either side of the Strait, not only are there large and high tectonic ranges of mountains in a conspicuous pattern separated by major consequent valleys and basins, the origin of which may be dated in all probability as early as that of the block mountains in the southern schist region, but also there has been both rejuvenation of older and creation of new tectonic forms, of which the most remarkable are valleys. This agrees with seismic evidence and is confirmed by the discovery of a great many fault cicatrices, or earthquake scarplets, of both the rejuvenating and the reverse kind. So it seems that development of features of minor relief within the boundaries of the large tectonic units is now in progress as a result of combination and cooperation of tectonic and erosional processes.

One of the most remarkable of the tectonic features now actually in course of development in the seismic region of the South Island is a terraced fault scarp which bounds the Hanmer Plain on its south side [1] (Fig. 3). River-cut terraces successively uplifted on the scarp of such a rising block or range are necessarily restricted to one bank of the river flowing along the foot of the scarp in a fault-angle consequent course. The down-tilted block of country north of this scarp is partly buried by aggradation, making the Hanmer Plain.

The extent and framework of the plain suggest great depth of alluvium beneath its floor, but much of the depression or downwarping responsible for the accumulation of this is probably of earlier date than the current phase of movement in which the fault scarp has been terraced during intermittent upheaval of about 500 feet. Here, as elsewhere in the region, this phase may be a recurrence of orogeny rejuvenating features already in existence.

In the Tararua Range of the North Island, there is a conspicuous example of a fault lineament or linear series of valleys of the kind earlier referred to

[1] C. A. Cotton, "The Hanmer Plain and the Hope Fault," *N.Z. Jour. Sci. Tech.* 29B (1947) 10–17.

Fig. 1. Fault scarps of humid and arid regions contrasted. P is potential initial form. A is sequential development under humid conditions, producing a fault scarp of Awatere type. B is sequential development under arid or semi-arid conditions, producing a fault scarp of Basin Range type. Fig. 2. Passage of a monoclinal flexure into a fault. In this case (a monoclinal scarp at Takaka, New Zealand) the structure of the cover, in a compound mass which is deformed or dislocated, determines erosional landforms indicative of the monoclinal or fault origin of the associated scarp. P is potential initial form. F is sequential form, fault scarp. M is sequential form, monoclinal scarp. Fig. 3. Production of a terraced fault scarp by intermittent active faulting, with development of a broad fault-angle consequent valley aggraded to make a basin plain (as is the Hanmer Plain, New Zealand). The plain is drained by a river leaving it (at left) by way of a terraced antecedent gorge through a rising range.

which may owe its development in some way not yet fully understood to transcurrent faulting. This lineament longitudinally traverses part of the axial range of the North Island a short distance west of its highest summits (Fig. 4). Its straight and deeply incised furrow is connected at its south-west end with the basin of the Akatarawa River by way of a V-shaped notch in the range. North-eastward from this it is occupied first by the south branch and then (beyond a V-notch wind gap) by the upper reach of the north branch of the Otaki River; though, beyond the junction (at Otaki Forks) of the south and north branches, this river leaves the furrow, passing north-west through a transverse gorge in

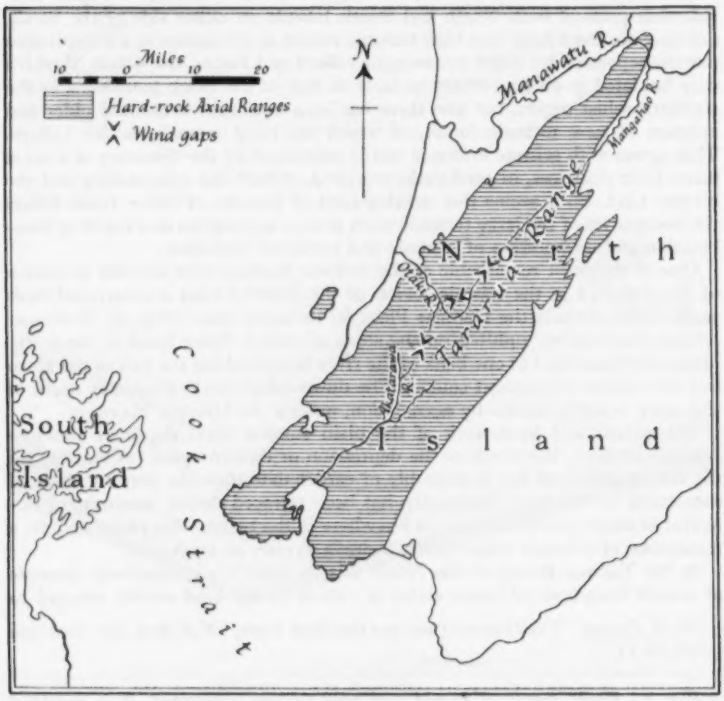


Fig. 4

the range. North-eastward, for many miles beyond another V-notch wind gap at the head of the Otaki north branch, the same straight furrow contains a great part of the length of the Mangahao River, a Manawatu tributary which is of sufficient volume to be an important source of power.

The lineament thus defined, which has not been previously described, marks the trace of a rectilinear major fault hitherto unmapped.[1] In the case of this

[1] I have followed the furrow throughout its length in an aircraft piloted by Mr. Allan Prichard, discoverer of the lineament, who was able to point out its details and their implication. The whole feature may be appropriately named the Prichard Furrow, or "valley" if preferred.

example, in the face of much evidence that orogeny is actively in progress in the Tararua and neighbouring ranges, it seems difficult to formulate and accept any explanation of the valleys other than a consequent one; but it is obviously necessary to give full consideration also to alternative hypotheses of subsequent or erosional fault-line origin to account for such river courses in rectilinear furrows.

DISCUSSION

Afternoon Meeting, 10 November 1952

Before the paper the CHAIRMAN (Professor S. W. WOOLDRIDGE) said: This Society is greatly honoured by the presence this afternoon of Professor Cotton of Wellington, New Zealand, who needs no introduction to most of those present. We are deeply in his debt for his many writings, and we welcome this opportunity of meeting and hearing him. Though it perhaps sounds a curious way of putting it, I will dare to call Professor Cotton the apostle of William Morris Davis to the British. In a sense, W. M. Davis needed no apostle, but Professor Cotton will not deny the measure of his appreciation of that great man whom he and I regard as the author and founder of our faith. But the great new science of geomorphology, as it was fifty years ago, owes an immense debt to Professor Cotton. I look forward to a good discussion on this vitally important topic of tectonic relief.

Professor Cotton then read his paper

The CHAIRMAN: I will not attempt, ladies and gentlemen, to thank Professor Cotton formally for his interesting lecture. I have followed the theoretical treatment with interest, reflecting how difficult it is to live in a world not of recent mobility but of extremely ancient dead mobility. If anything is needed to convey to us the reality of Professor Cotton's theoretical scruples about fault-line scarps, I am sure the views he has given will have widened our perspective.

Professor A. AUSTIN MILLER: I have had to wait a long time to thank Professor Cotton for all that he has done and all that he has published. Even before his two books on the "normal cycle" and "climatic accidents" were published it was always my practice to make my students read the first volume of 'The geomorphology of New Zealand' as being the clearest exposition of the evolution of landscape then available. Now I have to thank Professor Cotton also for the magnificent slides with which he has illustrated his exposition of tectonic relief.

In a way Professor Cotton is a natural response to his environment, because no geomorphologist living in that kind of country could neglect the wonderful examples of tectonic relief to be seen in New Zealand. We in the United Kingdom have not such good cases, but if we are going to find some in the British Isles, the nearest I can think of are the great boundary fault along the Welsh border at Church Stretton, and the Highland boundary fault where I have at times suspected that recent tectonic movements were in some way responsible for the vertical displacement of erosion surfaces. But on the whole tectonic influences are scarcely noticeable in Britain; and if they are to be detected we shall have to find some subtle sensitive criterion by which phenomena due to such influences can be distinguished from those which are due to erosion. Once we let go of the idea of base level as a sheet anchor we are really and truly adrift. I hope Professor Cotton will be able to tell us what are

the finer points we must look for when we want to recognize these influences if they exist in our scenery.

Dr. G. M. LEES: I feel sure that we have all been so fascinated by Professor Cotton's lecture and by his lantern slides that we are anxious to see them to the very end. It is, I think, unique to have in one person somebody who can think correctly of the proper balance between geological and geomorphological problems.

I would like to ask Professor Cotton whether he has attempted any analysis of causal processes. In all these problems of geomorphology one has everywhere this pulsating of levels, rising and falling of land forms, of down pulls on the one hand, and the great up-bulging of old erosional levels on the other. In certain areas it is very difficult to understand what the root cause is. For instance, the south island of New Zealand is just one block of what must be a tectonic zone of compression that extended far to the south. Why has it suddenly terminated in a rump end, as the map shows it?

I have been involved in a number of discussions in recent years on the question of isostasy. It is a very common answer to all problems to say that it is isostasy that makes mountains or that sinks oceans. Is that really so? We are all very eager to have an adequate explanation of the great undulations along mountain ranges. I feel sure that the word "isostasy" does not explain anything. One of the old supports of isostasy which crops up in every textbook is that Scandinavia has risen after the Ice Age through the removal of the great ice burden. That seems a nice and simple explanation, but when one looks at the earth forms elsewhere in the world one finds that there is almost no country which in a quite recent past has not undergone either uplift or depression.

I would like to thank Professor Cotton for a fascinating lecture and to ask him whether he ascribes the formation of the land forms in New Zealand to removal of the ice burden and whether he subscribes to the general view that isostasy is the active principle?

Dr. F. DIXEY: I should like to join the earlier speakers in their praise of Professor Cotton's lecture. It has been most stimulating and of great general interest to geomorphologists. I should also like to express my pleasure in and fascination by the photographs he showed,

The conception of a folded land surface that Professor Cotton has introduced is of special interest. It is not too difficult, perhaps, if the original surface had been a peneplane and then folded, to distinguish the tectonic forms from those of erosion; but as Professor Cotton indicated, if a mature formation is in anticlinal form, then it must be something of a nightmare to geomorphologists to try to distinguish the various forms.

Professor Cotton showed some photographs of terraces along the cliff of a rising "block" and it may be of interest to refer to events that might occur by erosion in successive cycles along the high-line scarp. In areas where there are sediments faulted down against older rocks, as in East Africa or along the Atlantic scarp, if the cycle that produced the scarp by erosion of the sediment below is sufficiently prolonged, that scarp will retreat to greater or lesser extent into the gneisses. I know of one fault which lies some two miles out in the plain away from the foot of the escarpment. At the top of the escarpment there is an old surface at about 7000 feet, whereas the surface below, mainly on the sediments, is at about 4500 feet, and during the erosion of that lower surface the fault-line scarp was eroded back some two miles. This main surface is now in course of dissection, and at no distant time geologically one might expect that a new quadrilateral scarp would develop along the fault itself, so that there would be two fault-line scarps which are producing two-cycle fault-line scarps.

Difficulties often arise in the interpretation of the various scarps. In East and Central Africa, for example, there is a vast range of scarps of different kinds from those described by Professor Cotton, and the argument still goes on as to the nature of certain of the scarps. It is possible that sediments which were eroded to form the fault-line scarp may be entirely removed so that there is no sign of them left, and yet the scarp is there. Along the foot of it is the gneiss on which those sediments rested, and the scarp may be driven back some distance from the actual fault-line. Therefore interpretation becomes exceedingly difficult. In some cases such scarps have been interpreted as actual fault scarps whereas they are in all probability fault-line scarps.

Professor Cotton showed scarps that were new to most people, and also some steeply inclined terraces. I do not know whether he has ever discussed very closely the means of distinguishing between those two on purely morphological grounds where the details of geology are not available?

Dr. H. L. RICHARDSON: I would like to say how much I enjoyed the lecture. I had the good fortune to be a student of Professor Cotton's rather more than thirty years ago, and so it is very much a return to old times so far as I am concerned. He inoculated me with an interest in geomorphology which has lasted ever since, and whenever I have travelled in other parts of the world, including China, it has been a constant fascination to study the land forms in the light of what Professor Cotton taught me.

There is one important point made by an earlier speaker on which I should like to touch; namely that New Zealand is particularly suited to this type of student of geomorphology. One has only to look out of a window of the University or to go for a Sunday afternoon walk to see all these things before one, whereas in England it is much more a matter of research. West China is another territory where there is a great deal of tectonic relief to be seen. It is a pity that one cannot visit that part of the world very easily now, because there are anticlinal ridges and lakes, the result of faulting, to be seen in West China very clearly indeed.

Professor C. A. COTTON: It was interesting to hear what Dr. Richardson said. If I live long enough, I shall go to west China.

As for the great problem of the cause of these movements, and their relation to isostasy, it would be dangerous to try to open such a problem now. But I do think that whereas vertical movement (and possibly some kind of gravity movement) is responsible for the fault scarps in the Great Basin of North America, in the coast ranges of California and New Zealand, and probably in many other parts of the Pacific rim, compressional faulting has definitely been the cause. But whether to think of compression or transcurrent movement on some very deep-seated vertical fault as the prime cause, I do not know.

In New Zealand I have toyed with the idea that all these apparently vertical movements and folds have been the result of the great transcurrent movement which, we are assured by Mr. Wellman, has taken place along the line that is now Fiordland, the line forming the western boundary of the southern Alps.

Dealing with the question of isostasy, I do not think there are other broad regions which have moved in the last 5000 or 10,000 years comparably to those which have been affected by the isostatic rebounds, as in Scandinavia and Labrador, that is to say regions which have moved so recently and to which one could point as not being glaciated areas, arguing from them that there has been some other force at work actively pushing upwards. As for New Zealand and isostatic rebound, there is along the east coast of Otago for a long way an elevated shore line, very well marked. It is a narrow coastal plain at some 30 or 40 feet above sea-level, but it is very far from the glaciated area. Eastern

Otago is not glaciated. I do not think that it was the result of isostatic rebound. I think it is more likely to be a eustatic feature. You will notice it is in an area which is away from the seismic region now moving.

As for Dr. Dixey's remarks, it is interesting to hear of other terrace scarps. Those which I showed in the photographs are very fresh and there can be no doubt in their case that they have had the origin I attribute to them. Johnson gives [1] an indication that there is no river along the base of the scarp, but there is apparently a development of pedimentation corresponding in position to what we must in New Zealand ascribe to river work.

The CHAIRMAN: I hope Professor Cotton will realize from the discussion and the attention that his lecture has had from all of us the high value that we place on it. I ask you to thank Professor Cotton in the customary way.

Professor Cotton then showed the remainder of his slides

[1] 'The geomorphologic aspect of rift valleys' (1929).

FROM THE *JOURNAL* A HUNDRED YEARS AGO

THE FOLLOWING EXTRACT is from a paper by Colonel Sykes, F.R.S., on Zanzibar published in the *Journal*, vol. 23 (1853) 101–119. It states succinctly the general view on the source of the Nile in the years immediately before the expedition of Burton and Speke. The Quorra is now known as the Benue.

"Mr. Rebmann has recently visited Jagga, about 300 miles inland from Mombas, in which territory he discovered the eternal snow-capped mountain, called Kilimanjaro, apparently in lat. about 3° S. and long. 36° to 37° E.; and Dr. Krapf penetrated to the Dana river, his route being to the N. of Rebmann's, and somewhat more extensive. At this point he saw another snow-capped mountain, called Kenia, apparently on the equator, and in long. 35° to 36° E. If we now consider this mountainous region continued from Abyssinia and Soudan, with its snow-capped mountains, but terminating abruptly about 6° S. of the equator, there is some reason to conclude that it is the location of the watershed of Equatorial Africa to the N., to the E., and probably to the W., for the missionaries show that the great Dana running to the E. has its sources in the neighbourhood of the Snow Mountains. The mysterious source of the real Nile, which had baffled the explorers of all ages, and which runs to the N. through so many degrees of latitude, is demonstrably traceable to the same snow-capped mountains of Kenia and Kilimanjaro, for Werne ascended the Bahr el Abiad, the White or true Nile, to 4½° N. lat., and about long. 32°; the stream still running down from the direction of the newly discovered Snow Mountains. The sources of the White Nile and the Dana, therefore, would seem to be within the comparatively small area of 3° or 4° of lat. under the equator, and the same number of degrees of long. between 32° and 36° E. If we now look to the western watershed of this region, the probabilities are in favour of some of the great western rivers being traceable to it, not excepting even the so-called Niger. Although no European has been to the eastward of Lake Chad in lat. 12° N., and long. 15° E., yet it was ascertained that the Shary entered the lake from the S.E., the very direction of Krapf and Rebmann's Snow Mountains on the equator; and to connect the Shary through the Lake Chad with the Quorra, alias the Niger, we have the authority of Captain Allen, R.N., who, ascending the Niger on the left bank, passed into a river much larger than the Quorra, and with a much greater volume of water, which he ascended for 100 miles, proceeding to the eastward in the direction of Lake Chad—facts which admit of the inference that this river is probably the continuation of the Shary through Lake Chad, and that the sources of the *true* Niger, in common with the true Nile and the Dana, may be found in the Snow Mountains under the equator; for the *minor* stream which runs past Timbuctoo, and has its source in Western Africa, can as little maintain its claim to be the true Niger, against Captain Allen's affluent of greater magnitude than itself, as Bruce's Nile can maintain its claim to be the true Nile since the explorations of Werne and others of the Bahr el Abiad or White Nile. Another important fact mentioned by Krapf, and which is likely to materially facilitate the labours of explorers, is, that one family of languages, with cognate dialects, exists in Africa S. of the equator, excepting I presume the Hottentot and Bushman tongues. With the advantage therefore of ready access to the interior from Mombas, with tribes evidently not hostile to Europeans, from the treatment the missionaries experienced, and with the means of travelling by caravans at least to the Wakambas, circumstances seem to combine to invite exploration in this new field, and doubtless the love of enterprise which characterizes our countrymen will, at an early period, induce some gallant heart to attempt the solution of geographical problems which have baffled inquirers for so many ages past."

LAND AND POPULATION IN EAST AFRICA

LAND AND POPULATION IN EAST AFRICA: Exchange of correspondence between the Secretary of State for the Colonies and the Government of Kenya on the appointment of the Royal Commission. *London: H.M. Stationery Office*, 1952. 9¹/₂×7¹/₄ *inches;* 33 *pages.* 1*s* 3*d*

THE IMMEDIATE PROBLEM facing the East African territories is clearly set out in the dispatch to the Colonial Secretary, written by Sir Philip Mitchell when he was still Governor of Kenya, which has been published as Colonial No. 290, 1952. This problem is the congestion of population in certain districts beyond the carrying capacity of the land, while large areas remain unused or only thinly populated. At the same time, the long term problem must be met of how best to plan for the rapidly increasing population which it is estimated may double itself in thirty-five years in some districts. Running parallel with the increase in human population is an increase in numbers of stock, resulting in serious overgrazing.

The greater part of the document is concerned with possible solutions of these problems, and a discussion of the difficulties to which the solutions may themselves give rise. It first deals with the suggestion, often repeated, that tribal lands should be enlarged by adding more land for cultivation by traditional methods under traditional systems of tenure, and pays special attention to the lands contiguous to the Kikuyu reserve which have been alienated to European settlers. It is perhaps a pity that an attempt should have been made in this context to justify the alienation on equitable as well as on economic grounds. The arguments for and against European appropriation are too long and complex to be stated in a few paragraphs and the introduction of certain statistics only serves to draw attention to the omission of others. Indeed, the main argument set out in the dispatch against the expropriation of European land is not based on moral grounds but on the contention that peasant farming by primitive methods cannot provide a tolerably high standard of living and that therefore the addition of land for cultivation by such methods is no solution at all. To quote from the dispatch: "The failure of tribal agriculture to meet the needs of an expanding population is indeed the general experience. The cause of failure lies in the inability of traditional peasant agriculture to do more than maintain the population at an unsatisfactory subsistence level, and then only if shifting cultivation can be practised, new clearings made when old are exhausted, and whole regions thereby laid waste by desiccation and erosion."

To find a workable solution the dispatch turns to the full development of the economic resources of East Africa, which are classified in two main groups: land and industries. It is admitted that the African farmer must remain an essential element in the economy of East Africa, "but only as a farmer who has been emancipated from his old tenures and practices, who is prepared to work hard and intelligently on his farm, and who is backed by all the assistance which can be given to him by central and local authorities, by science and sound agricultural techniques, within the limits of the finance available." The case for mixed farming is stated. So is the need first to persuade owners to sell surplus stock and second to devise methods of getting this stock to potential markets. The latter problem is thought to be greater than the former, in spite

of the economic and prestige value of cattle in many present East African societies. The need to make use of the empty or half empty land in which all East African territories abound by means of efficient and permanent agriculture is also emphasized.

But while believing that the land must support the greater part of the surplus population, the dispatch states that a full solution can only be found by expanding the opportunities for paid employment in industries, both without and within the areas mainly occupied by Africans or reserved for them. It describes the economic and social revolution which began fifty years ago and which is resulting in adjustments by the Africans themselves of their land-holding system and tribal ways of life. The enclosure, sale and exchange of land by Africans is proceeding apace, particularly in the most favoured areas where cash crop farming has proved profitable. Another effect of this revolution has been the creation of growing urban populations of wage earners who do not earn enough to support their families. These families therefore remain in the tribal areas to add to the congestion of population and to the despoiling of the land by their primitive methods of subsistence farming.

The industrial revolution, which must be speeded up in order to give paid employment adequate for the needs not only of the wage earner himself but of his family, raises a further wide range of problems at present unresolved. These are summarized as the East African low wage economy; labour efficiency, to which is related training and education; health, nutrition, housing recreation and security in old age. Many existing East African industries are experiencing an acute shortage of man power in spite of overpopulation in neighbouring areas, and incentives to encourage recruitment of wage earners must be found.

The dispatch also stresses the need, in considering a general rise in the level of African wages, to keep in mind the importance of maintaining a fair balance between conditions of living and employment of wage-earners and those of the new, industrious and scientifically-minded African farmer who it is hoped will shortly emerge from the congested areas. In this connection it is interesting to refer to an account of the economy of experimental small holdings[1] farmed intensively under Government supervision in Nyanza Province, Kenya. Taking the average family group as 5·69, and assuming that the adult members of this group will work an eight hour day, it appears that a farm of 11–14 acres is necessary to keep the family in food, and to produce a cash income from sale of surpluses of £20 a year. This means that each member of the family receives about £3 10*s* 0*d* a year for clothing, taxes, school fees and spending money. These conditions are certainly not paralleled in those favoured areas suitable for cash crops of coffee or cotton, such as Buganda, Buhaya or the lower slopes of Kilimanjaro, but may be typical of less favoured but far more widespread areas throughout East Africa.

Having surveyed the problem, the letter recommends the appointment of a Royal Commission to study the complex issues involved. The terms of reference of this Commission are published with the document. The task of the Commission of particular interest to the geographer is the framing of recommendations with reference to the opening for cultivation and settlement of land at present not fully used and the development and siting of industrial activities; but the whole scope of the Commission's work shows the need for basic research and for the correlation of the existing information, often of considerable value, lying uncoordinated in various Secretariat or District Office files.

[1] E. L. Bradford, "African mixed farming economics as applied to Bukara, Nyanza Province, Kenya." *East African Agricultural Journal*, vol xii, October 1946.

While land betterment schemes within areas already settled are able to draw on current experience, plans to break new ground demand adequate knowledge of the physical conditions to be met, if they are to be successful. Examples of failure resulting from action taken without this knowledge are only too numerous, the ground-nuts scheme of Tanganyika being the most spectacular.

In many cases, the under-developed areas to which the dispatch refers remain empty or thinly peopled because of infestation by tsetse fly, lack of communications, poor water supplies or inadequate effective rainfall. Often all these circumstances combine to keep out would-be settlers. The problem of tsetse can be dealt with by bush-clearing; lack of communications by administrative action, given the necessary funds; in a few areas, such as the Rufiji valley in Tanganyika, seasonal flooding of rivers enables irrigation to be practised; water holes may be bored to tap lower ground water supplies, and tank dams constructed; but as yet rainfall remains uncontrolled by Government. The overpopulated areas all lie either in the Lake Victoria region or in highland districts which receive a higher rainfall than the greater part of East Africa. When these islands of higher rainfall become overcrowded, expansion must take place into the marginal lands which have a low effective rainfall often irregularly distributed, and it is here that failures are most likely to occur.

Rainfall statistics over a period of years for land previously uninhabited cannot of course be conjured from the air. Nevertheless it is impossible to overstress the importance of using whatever statistics are available in a territory like East Africa, where in the lower rainfall areas the only normal feature of the rainfall regime is its abnormality. Under these conditions, average annual rainfall totals become misleading. For instance, Makueni, the home of the resettlement scheme quoted in the letter, is said to receive an average annual rainfall of 22 inches. In 1951 over 60 inches of rain fell. It is clear that even occasional years with a high fall of this kind must be offset by years in which the annual total rainfall drops well below the average in order to achieve a mean annual rainfall of 22 inches. Such a consideration throws rather an ominous light on the words in the dispatch: "Here is a place which was uninhabited; to-day over 400 families are established with their livestock on the land and after two years of drought are in good heart and proud of their achievements"; and on the report of the Kenya Agricultural Department for 1951 that basic husbandry rules at Makueni had not been rigidly insisted on from 1949–51 because of drought conditions and the fear of deterring new settlers; but that with two good crop seasons in 1951, it should be possible to insist upon the adoption by settlers of these rules of good husbandry in 1952.

Nor is the very wide range of actual total rainfall received from year to year the only important factor. In East Africa, the growing season depends on rainfall, and not on temperature which is sufficient everywhere, except on the highest mountain slopes, to allow plant growth at all times. The seasonal distribution of rainfall determines the length of the unproductive seasons each year, and failure of either the long or short rains brings with it failure of crops. Rainfall statistics available for Makindu, some 60 miles south of Makueni, show wide variations in the amount of rain received in both the long and short rainy seasons from year to year. They also reveal variations in the degree of effectiveness of rainfall. In 1946, for example, 100 per cent. of the March rainfall, amounting to 1·21 inches, fell within twenty-four hours. March is a critical month for crop planting and growth. If the total rainfall for that month falls in one day, its effectiveness is very much lowered.

This unreliable rainfall regime is typical of much of the marginal lands in East Africa; yet it is in these areas that part at least of the answer to the two

problems set out in the dispatch must be found. The solution of the immediate problem, namely the disposal of excess population from certain districts where congestion is greater than the carrying capacity of the land, calls for resettlement of population in newly opened areas. The necessary task of correlating what information is available on rainfall, topography, soils, vegetation, water supply and existing population distribution, and of instituting field studies to make good deficiencies in such knowledge, is one in which the geographer is well qualified to take part. He also has a contribution to make to the industrial planning which will be necessary to utilize the resources of East Africa to the full.

The immediate problem is pressing, and at present resettlement schemes must be carried out on the basis of the knowledge available, or rapidly obtainable. But the long term problem of the disposal of the increasing population of the future gives an opportunity for more careful research. Probably the greatest need is for full rainfall statistics over a period of years, particularly in marginal areas. Against the plea of the expense of expanding the meteorological service of East Africa must be weighed the costs of failure. The Makueni scheme, which is far from being a failure, had between 1945, when clearing began, and 1950 settled 110 families at the staggering cost of £1000 a family. Admittedly this figure includes the provision of staff housing, a school, dispensary, offices, silos, a cattle dip and miscellaneous equipment such as tractors and lorries. But if this is the cost of resettlement in marginal lands, then no East African territory can afford to allow such schemes to fail. An interesting comparison may be made with resettlement in Kigezi, Uganda, where well-watered land with an adequate, well-distributed rainfall was empty because of tsetse infestation. Here were none of the problems of marginal land and 15,000 people were resettled between 1946 and 1949 for the cost of 24 shillings a head exclusive of the loss to revenue of the remission of two years' poll tax granted to settlers.

Research is clearly needed. If it is carried out, however, it is to be hoped that its fruits meet with a better reception than that given in the Report of the Joint Agricultural and Veterinary Services Sub-Committee to the Development Committee of Kenya in 1946, which, on the subject of researches into land tenure, stated "Inquiries into land tenure in certain areas have been carried out by special committees, *e.g.* in the Kikuyu Reserve some 18 years ago. The information available from these sources, whether out of date or not, is factual and academic in character, and cannot be regarded as of great practical value except as a background for further study."

JEAN FORTT

THE GEOGRAPHICAL STUDY OF ARCHAEOLOGY

ARCHAEOLOGY IN THE FIELD. By O. G. S. CRAWFORD. *London: Phoenix House*, 1953. 10×7 *inches; 280 pages; maps and illustrations.* 42*s*

A NEW BOOK by the Editor of *Antiquity* and former Archaeology Officer of the Ordnance Survey is a notable but not a rare event. Two major works published since his retirement, on subjects as diverse as the topography of Roman Scotland north of the Antonine Wall and the medieval Fung Kingdom of Sennar, testify to his industry as well as to his high standards of scholarship, backed by extensive field work. They testify also, as does this latest contribution to the geographical study of archaeology, to Mr. Crawford's early geographical training and to his persistent championship of the geographical point of view.

The influences that have shaped Mr. Crawford's outlook in this respect are worth recording. In early days, he was, as he puts it in Churchillian metaphor, much mixed up with the development of human geography and with the Oxford School of Professor Herbertson. The latter was then teaching the importance of environment in the study of modern communities. In the historical field, an outcome of this new approach was Professor Myres's masterly account of the influence of geographical environment upon the ancient civilization of the Mediterranean.[1] It was not long before the geographical technique came to be applied to archaeology. Abercromby published a distribution map of beakers in Great Britain. Mr. Crawford himself followed by mapping the distribution of certain types of object of the Early Bronze Age and found not only coincidence but a very obvious geographical explanation of the grouping of the sites. Abroad, Schliz had done the same with certain neolithic pottery whose distribution was found to coincide with that of the loess formations. In Germany, eventually, this geographical approach to archaeology gave rise to the important concept of *Kulturkreis* based upon the groupings that such distribution maps reveal. It was the outcome of a process dating back to the first half of the nineteenth century, fostered by the geographers von Humboldt and Ritter and developed by the historians Müller and Curtius. Müller's 'Histories of the Greek People and Cities' (1816) and Curtius's 'Peloponnese' (1851) consolidated the partnership between geography and history, in which archaeology subsequently joined.

All this was more than forty years ago. Since then, this insistence on the importance of the space as well as on the time aspect has characterized all Mr. Crawford's archaeological work. Among geographers, perhaps the best known outcome of it will be the valuable period maps such as those of Roman Britain and of Britain in the Dark Ages published by the Ordnance Survey. And geographers would be the first to agree with Mr. Crawford's assertion that the archaeologist or historian who has not disciplined himself in terms of both these fundamental dimensions will never really understand his subject.

Mr. Crawford's latest contribution to the geographical study of archaeology is concerned with the observation and recording, above all on maps, of the surface remains or surface evidence of the past, without excavation. By relating particular facts to general principles, students are shown how best to pursue

[1] *Cf.* The collected essays in Sir John L. Myres's 'Geographical history in Greek lands,' Oxford, 1953.

their task. Roman roads and prehistoric tracks, Celtic fields, earthworks, huts; megalithic monuments and round barrows; medieval castle mounds and medieval parks and cultivation banks; all these are dealt with in reference both to the technological basis of culture and to geographical environment. There is, despite the title of the book, much here of importance to the geographer, and such laconic headings to chapters as "Ponds" and "Linear Earthworks" cover in fact essays on the agricultural, pastoral and economic prehistory of Wessex. Mr. Crawford then outlines the work that remains to be done, or at least that ought soon to be done, not only in this but in other countries. This is not perhaps a time when the geographical study of the ancient past is much favoured by professional geographers. But there will undoubtedly be some who will find among Mr. Crawford's suggestions attractive lines of research. And some of them will certainly appeal to those small University expeditions, working in a number of different disciplines, which proceed abroad in the long vacation to study the past and present geography of a region.

Great Britain, largely through the close association between the archaeologists and the national map-makers dating back to the eighteenth century, has been comparatively well covered by field archaeology. In France, on the other hand, and in the Iberian Peninsula, there has been practically no field archaeology in our sense of the word. Farther afield, the semi-deserts round the edge of the Fertile Crescent are largely unexplored areas. Work on the field systems of the desert margin is one suggestion Mr. Crawford makes. In Iraq, especially, there are great possibilities for field work.[1] Here, as indeed almost everywhere, air photography is an essential aid and one in the use of which for archaeological purposes Mr. Crawford was the pioneer. His suggestion for Iraq is a good example of work to be done. From air photographs taken along the great derelict Nahrwan canal above Baghdad a valuable map could be constructed, showing ancient towns and irrigation systems. This could be checked against the descriptions of ancient and medieval geographers and related to modern development schemes. In north Africa, the reconnaissances and mapping in Cyrenaica and Tripolitania which Mr. Goodchild has described in this *Journal*[2] have already yielded important information on the past geography of these areas; on climate, on water-supply, on the development of agriculture, all of which have a bearing on schemes for the economic future of Libya. And here and in other countries as close to hand as France and as distant as Turkey, the recording of Roman communication systems and of habitation sites in their strategic and geographical context is a contribution to the International Map of the Roman Empire; a by-product of the 1/M International Map of the World, now centralized in the United Nations Social and Economic Council. One might add that in the Sudan, along the Nile valley above the Third Cataract, surveys are of immediate importance before flooding as the result of new Nile projects obliterates the evidence. The region is an important one in which transition from a rainless zone to one of annual rainfall coincides with persistent cultural, linguistic and political differences. These are a few only of the suggestions for future research. There are many others, ranging from Central America to Siam, to stimulate the field archaeologist.

The earlier chapters of Mr. Crawford's book are concerned with the history of the development of field archaeology. One chapter, as might be expected,

[1] *Cf.* Lees and Falcon, "The geographical history of the Mesopotamian plains," *Geogr. J.* 118 (1952) 24–39.

[2] R. G. Goodchild; "Mapping Roman Libya," *Geogr. J.* 118 (1952) 142–52, and "Roman Tripolitania; reconnaissance on its desert frontier zone," *Geogr. J.* 115 (1950) 161–78.

deals with archaeology and maps; an association personified in General Roy (1726–90) who was not only the effective founder of the Ordnance Survey but may also be regarded as the founder of modern field archaeology. He incorporated in his Map of Scotland his military interest in Agricola's campaigns in that country and his "Military Antiquities of the Romans in Britain" is a landmark in the history of the subject.

During the nineteenth century, field archaeology made little advance, though a great stimulus had been given by Sir John Sinclair's Statistical Account of Scotland (1791–99), based on replies to a widely circulated questionnaire. Towards the end of the century, there was a revival. Then, in 1920, the long association between the archaeologists and the national map-makers, encouraged by General Roy and the early Directors General of Ordnance Survey who caused remains of the past to be marked on the original one inch to the mile maps, bore fruit in the appointment of Mr. Crawford as first Archaeology Officer to the Survey. Those who read this important book will learn that this appointment, the start of a long and distinguished service in the geographical study of archaeology, was due to an eminent President of this Society (then Director General of Ordnance Survey), the late Sir Charles Arden-Close.

Much has been said in favour of this book and it is time to note a few defects. Some who, like the writer, prefer to think of archaeology rather as ancillary to history than as an end in itself will not agree with Mr. Crawford's incessant declarations about the independence of archaeology; by which he means, surprisingly enough, independence from literary and epigraphic evidence. Others, with experience different from Mr. Crawford's, may think that Roman Britain is by no means unique as an ideal training ground for the young. A more notable defect is the amount of repetition the book contains, due no doubt to its expansion over the years from a set of University lectures to its present substantial size. Size, and price, and the number of misprints could with advantage have been reduced by closer editorial scrutiny.

The illustrations are good; the maps and plans, though not stylish, are competently done.

L. P. KIRWAN

REVIEWS

EUROPE

THE SHORTER CAMBRIDGE MEDIEVAL HISTORY. By the late C. W. PREVITÉ-ORTON. Vol. I. The Later Roman Empire to the twelfth century. Vol. II. The twelfth century to the Renaissance. *Cambridge University Press*, 1952. $8\frac{3}{4} \times 6$ *inches;* xxii + 1202 *pages; illustrations and sketch-maps.* 55*s* the two volumes

To summarize the volumes of the 'Cambridge Medieval History' into two manageable volumes was a considerable undertaking, and could have been achieved only by a medievalist with the knowledge, patience and enthusiasm of the late Professor Previté-Orton. The result is an integrated survey of all the diverse aspects which reflect the ideals, achievements and failures of a millenium of European history. While the main theme is inevitably political and ecclesiastical, the cultural and economic background is not neglected, and the whole forms at once a work of reference and a continuous history capable of being read as such. It has been edited for the press by Mr. Philip Grierson, who has increased its usefulness by adding genealogical tables and lists of rulers. The main and most instructive additions are the three hundred illustrations, brought together from a wide variety of sources with the help of Dr. S. H. Steinberg, which are more than mere appendages to the text. The sketch-maps, on the other hand, might have been more informative. G. R. C.

ASIA

SIEBEN JAHRE IN TIBET. By HEINRICH HARRER. *Wien: Ullstein Verlag*, 1953. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 268 *pages; map and illustrations*

Heinrich Harrer, a member of the German Nanga Parbat expedition of 1939, was interned at Dehra Dun on the outbreak of war. After two unsuccessful attempts, he and several others escaped in 1944 and crossed the Tibetan frontier. With another mountaineer, Peter Aufschnaiter, he determined to make his way to the Japanese lines in Burma. At the end of the war, fearing that they might still face several years' internment in India, and by now under the spell of Tibet and its people, they resolved to reach the "forbidden" city of Lhasa. There they remained until the spring of 1951, when Chinese forces were approaching the capital.

This is a bald summary of an attractive book. One aspect of it covers the details of the planning and carrying out of the journey; the break-out from Dehra Dun; their evasion of Tibetan authority and arrival at Lhasa without official permission; the rigours and hazards of the journey, part made with little equipment in winter at altitudes of 5000 metres. All these are the elements of a first-class adventure story with excitement and suspense well maintained. The other aspect, the descriptions of the country and, particularly, of the Tibetans encountered, with the account of the crisis in Lhasa, is equally arresting and of lasting interest.

Their route took them through Gartok, past the sacred lake of Mansarowar, down the upper course of the Brahmaputra to Tradün and thence southwards to Kyirong, when they were officially presumed to be on their way out to Nepal. On parts of their itinerary they had probably been preceded by no

more than half a dozen European travellers. At Kyirong they were detained for several months, awaiting permission from Lhasa to go there. Growing tired of their second confinement, they made another dash for liberty and struck north-eastwards for Lhasa.

One outstanding impression is of the almost unfailing friendliness, hospitality and good humour which they encountered among the Tibetans. Another is of the great gulf between rulers and ruled in this feudal society. It is not surprising that the author considers the expectation of life to be not much above thirty years. In contrast to the hard life of the nomads and peasants, the standards of life and culture in Lhasa are surprising.

After much uncertainty, the two foreigners were allowed to reside in the city, where they made friends with the leading personages, having acquired a working knowledge of Tibetan on their travels. Harrer eventually became a daily tutor to the young Dalai Lama. He draws an attractive and rather pathetic sketch of this highly intelligent, alert and lonely youth, who did not accede to full power until shortly before the Chinese invasion. The book concludes with an account of his flight to India. Harrer writes directly and spiritedly, with touches of sentiment. He claims to have collected topographical material and to have made rough surveys of certain areas, but these are excluded from this general narrative. This will doubtless be the last book of contemporary travel in Tibet for a long time, and it is not unworthy of the rich literature which preceded it. G. R. C.

AFRICA

ISLAM IN ETHIOPIA. By J. Spencer Trimingham. *London: Geoffrey Cumberledge*, 1952. 8½ × 5½ *inches;* xv + 299 *pages; maps.* 25*s*

Despite a relative profusion of primary source research material on Abyssinia summarized in the bibliographies of Fumigalli, Zanutto and more recently of the New York Public Library, I believe there is not one study in English of the rise of Islam in this part of Africa. This survey, based on first-hand material collected by travellers, orientalists, ethnologists and others, has the value of presenting such knowledge in accessible form. The general treatment is on similar lines to that of 'Islam in the Sudan,' but with greater objectivity. There is a description of the region and its peoples, a study of the interaction of Islam and Christianity, the tribal distribution of Islam, with its local characteristics, including the various "rites" (*madhhab*) and brotherhoods (*tarīqah*).

Islam and Christianity have fought out their destiny against an ever-receding paganism mingled with elements of cultures introduced by earlier phases of Semitic colonization and of Jewish proselytization. The absence of fanaticism on either side, and the complicated movements of peoples contrasting with the comparative stability of society in the Arabian homeland of Islam, are distinctive features of that struggle.

The analysis of the process of Islamisation reveals a pattern not only common to the Muslim world, but similar to the way of the early Christian fathers. The conversion of tribes is linked with legends of saints from Arabia who gave the leading families an aristocracy of Arab blood, eventually turning the whole tribe to Islam. Pagan life is gradually changed over to Islam, custom and belief being adapted by an alteration of emphasis, while that which is un-Islamic is eliminated piecemeal; but the conflict of *sharī'ah* with customary law and lack of knowledge of Islam amongst Muslim tribesmen is exactly true also of Southern Arabia, the towns of which have long been centres of Islamic learning. As the author says, this process reduces the psychological shock involved in the

change of religion to a minimum, but Islam, in time, recreates the life of the new believer.

One cannot however concur in the statement that "Islam has tended to claim the sympathy of Western rulers partly because it represents a higher civilization, and it has been long before they realized how unappeaseably it is opposed to Western culture and that it is in danger of leading Africans up a blind alley." As, according to Trimingham's own statement, Islam has at first little disruptive effect on pagan institutions, it is surely eminently suitable to replace paganism when that no longer satisfies, while on its higher planes it can offer an intellectual satisfaction not inferior to that of other world religions. Its stricter code on practical issues like the use of alcohol, and treatment of the marriage institution, less rigid than in Christianity, are particularly suitable for primitive societies and can work successfully in advanced communities. Essentially too practical to reject Western culture, Islam endeavours to purge it of elements distasteful to itself.

Trimingham justly assesses the importance of education in Islamization, the part played therein by Yemeni and Hadrami immigrants and the tarīqahs. Abū Bakr al-'Aidarūs who brought the Jīlānī tarīqah to Harar was of Hadrami origin,[1] and the stream of Saiyids to Ethiopia has continued uninterrupted till the present day.

It is somewhat of a surprise to learn that the ratio of Muslims to Christians is about two to three, and to realize the extent to which, for political reasons, the Italians fostered Islam in Abyssinia. With such division in faith and diversities in race, it will be interesting to see what changes will be produced by a new factor—the nearer approach of Western culture, fundamentally so devastating to medievalism, Muslim and Christian alike. R. B. S.

GENERAL

THE COLUMBIA LIPPINCOTT GAZETTEER OF THE WORLD. Ed. by L. E. SELTZER, with the geographical research staff of Columbia Univ. Press and with the cooperation of the American Geographical Society. *New York: Columbia Univ. Press*, 1952. 12×9 *inches;* x+2148 *pages.* £16

The 1905 edition of Lippincott's indispensable gazetteer was re-issued, with an appendix for the United States, in London in 1912. Since then, except for 'Webster's Geographical Dictionary' (Springfield, Mass., 1949), the only up-to-date and comprehensive list of names available for the world has been the 'Dictionnaire des Bureaux de Poste' (fifth edition, Berne, 1951), which is effectively a mere list of inhabited places. The task of bringing Lippincott's gazetteer up to date has been courageously undertaken and achieved, but the acuteness of the need for such a work stands, unfortunately, in direct proportion to the instability of the state of international affairs. The new edition is up to date for India, but is already out of date for Persia. It is, nevertheless, what the old edition was, an indispensable work of reference. It is open to criticism on a matter of principle, and on numerous points of detail. It states that "a place has been listed under its English name, when it clearly has one; . . .", but the omission of nearly all diacritical marks but those used in western European languages, the translation of terms, particularly in Russian and Japanese names ("Lesser Northern Dvina River"), and occasional transliteration even from

[1] His biography can be consulted in al-Nabhānī, Jāmi' Karāmāt al-Awliyā', Cairo (1329 H.) I, 263. He is said to have gone to Zaila' about 880 H. (A.D. 1475) which was then ruled by a certain Muhammad 'Atīq.

Roman alphabets (Beshchady Mountains for the Polish name Bieszczady—which is not followed by the word Góry in Polish), shows that a large number of what are really new English forms has been introduced. This has been intelligently done, for the quality of the editorial work is of the highest; but it has not been consistently done. We are offered Tsetinye as an alternative to Cetinje, but not Erzinjan for Erzincan. We are also offered as English a few names like Little Carpathian Mountains, White Carpathian Mountains, Slovak Ore Mountains and Greater Fatra, which have no standing in contemporary British usage. The gazetteer gives the foreign forms in brackets, and with scrupulous care, but in the main entries they have been adapted to the resources of popular printing for alphabetical arrangement and general use. From the first International Geographical Congress (Antwerp, 1872) to the fourth Congress of Onomastic Sciences (Uppsala, 1952) geographical authorities have striven for the general acceptance of the official forms of names officially written in Roman alphabets; but, if the sponsors of the most authoritative gazetteer in the English language cannot apply this measure, should we not question its practicability, at least for national purposes? Unfortunately the need for the coordination of international usage remains.

The gazetteer seems weak in its references to the units of government, particularly of local government. Amsterdam is described as the "constitutional" and the Hague as the "de facto" capital of the Netherlands—odd expressions, as the Hague is certainly the capital *de jure*. It is difficult to decide, from what is said, whether the Ryukyu islands are under a local civil government, under American protection, or under both. The City of London and the County of London are treated under one entry, with no appreciation of the status of St. Paul's as the cathedral church of the City and of the Abbey as that of the City of Westminster. The Abbey is accorded the honour which belongs to Canterbury Cathedral as "premier church of Great Britain." There has been little attempt to distinguish between the British ancient counties, registration counties and administrative counties, and it is a pity that the Ordnance Survey has not been accepted as the authority for their names. It is unsatisfactory to find Lincoln and Lincolnshire, Aberdeen and Aberdeenshire, given as alternatives, and the instance of "Dumbarton or Dumbartonshire" is officially wrong, Dumbarton being the town and Dunbartonshire the county. Of misinformation the work is rarely guilty, but the neighbourhood of Stoke-upon-Trent is said to be a source of China clay, and, in the article on Lake Chad, Clapperton is referred to as Chepperton. Minor errors or misprints show up rather frequently: the longitude of Ploeşti is 26° 02′, not 25° 02′ E., and that of Sibiu is 24° 09′, not 29° 09′ E. Fukui is 80 miles, not 28 miles, N.N.E. of Kyoto. Háná is given for Haná, Babí Hora for Babia hora, and Nis for Niš And the selection of small places for admission seems to have been somewhat arbitrary judging from the treatment of Great Britain. In spite of such blemishes the gazetteer is a most satisfactory tool of trade to the professional geographer, and answers his contingent questions more readily than any other work of the kind. No computation of the number of names it contains has been made, but the page of the new edition is an inch and a half bigger both ways than the old, is printed in three columns instead of two, and there are 2148 pages as against 2105. The greatest contrast is in the price, for the issue of 1912 cost a mere two guineas. The first and last signatures of the new edition are printed on a heavier paper than the rest, but the paper is too light for its bulk, and the binding too weak for the weight. It would have been handier and more durable in two volumes.

M. A.

THE TROPICAL RAIN FOREST. By Professor P. W. RICHARDS. *Cambridge: University Press*, 1952. 10×6½ *inches;* xviii+450 *pages; maps, illustrations and diagrams.* 63*s*

Professor Richards writes for zoologists, geographers and anyone concerned with the tropical rain forest as an environment, as well as for botanists. Those who enter a primeval forest for the first time will be struck by the immensely tall trees with their trunks bare of branches and small tops, as described in the opening chapter. Professor Richards draws attention to the relative lack of undergrowth and to the fact that the trees are in several stories. Only certain species reach the great height characteristic of the uppermost story; others remain always in the lower stories. In a later chapter he discusses some of the most striking phenomena: the thin smooth bark, the buttresses, stilt-roots, up-growing roots (pneumatophores), drip-tips, and flowers and fruits which spring directly from the trunks of the trees. This last phenomenon is termed cauliflory. Later chapters deal with the ground herbs and epiphytes (often misnamed parasites), climbers and saprophytes which inhabit the rain forest. The effects of environment such as light, rainfall and soil conditions are dealt with as is the succession of species when the forest colonizes new ground. The final chapter discusses the effects of man's wholesale destruction of the primary forest and the book concludes with an extensive bibliography. A. H. G. A.

MAPS AND DIAGRAMS. By F. J. MONKHOUSE AND H. R. WILKINSON *London: Methuen*, 1952. 8½×5½ *inches;* xvi+330 *pages; maps and diagrams.* 25*s*

MAP INTERPRETATION. By G. H. DURY. *London: Sir Isaac Pitman*, 1952. 8½×5½ *inches;* xii+203 *pages; illustrations and diagrams.* 15*s*

It is both fortuitous and fortunate that these two books should appear at the same time for they are complementary studies in cartography. Taken together, the two volumes are likely to become basic works for most university students reading for their first degree in Geography. Hitherto, scattered journals or expensive reference works have contained the students' material; these new books will undoubtedly fill a long felt want. 'Maps and diagrams' will also be of interest to specialists in climatology, history, economics and others who are concerned with the compilation and construction of maps and diagrams. A wide and comprehensive survey of the whole range of this fascinating subject has been very successfully attempted and presented in an admirable way.

Materials and techniques are covered in a fairly extensive first chapter, followed by successive sections dealing with Relief Maps and Diagrams, Climatic Maps and Diagrams, Economic Maps and Diagrams, Population Maps and Diagrams, and Maps and Diagrams of Settlements. Very little seems to have been omitted in this survey and many will find much new material in either the text or in the two hundred illustrations. A book of this nature does not call for any detailed treatment of map projections but it would seem desirable to add in any revised edition a short statement stressing the need for, and outlining the principles of, the right choice of projection before compiling small-scale maps. The geographer will know of this need but probably not the other specialists.

Cartographers are well aware that geographers and others who present their data in map and diagram form often fail to make the most of the medium at their disposal. The resulting efforts can frequently be criticized on the grounds of presentation, errors and omissions. The book by F. J. Monkhouse and H. R.

Wilkinson should materially assist in reducing and remedying many of these defects.

'Map interpretation,' by G. H. Dury, shows how the compiled topographic map may be interpreted. Map interpretation is not an easy topic to discuss in print and the problem is here approached by the consideration of specific examples. A carefully selected series of British and foreign sheets are analysed both physically and culturally. The industrious student will find the interpretation of the type areas of great value when he comes to make his own analysis of other similar regions. The descriptive analysis of the selected maps is excellently carried out but it would seem desirable to include in a volume of this nature some examples of subsequent synthesis into geographical regions. Only topographic maps are considered and the student must still turn elsewhere for the interpretation of certain geological, climatological and economic maps. The volume concludes with a chapter on morphometric analysis and a contribution by H. C. Brookfield on cartographic appreciation. Both books contain prolific references, are well produced and very reasonably priced.

W. G. V. B.

BLIND WHITE FISH IN PERSIA. By ANTHONY SMITH. *London: Allen & Unwin*, 1953. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 231 *pages; maps and illustrations.* 16*s*

THEY CAME TO THE HILLS. By CLAIRE ELIANE ENGEL. *London: Allen & Unwin*, 1953. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 275 *pages; illustrations.* 21*s*

LAND UPLIFTED HIGH. By JOHN PASCOE. *Christchurch: Whitcombe & Tombs*, 1952. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xii+235 *pages; maps and illustrations.* 18*s* 6*d*

The first of this trio is the lively and highly enjoyable account, written by a youthfully enthusiastic and intelligent zoologist, of an expedition by four Oxford science students to the region round Kirman, in south-east Persia. They had heard the report that blind white fish existed in the *qanats*, the deep underground waterways supplying Persian towns and villages, and set out to make a fourfold investigation in the district, the chemist digging for soil samples watched by curious inhabitants, the geographer making measurements, the botanist collecting dry plants and the zoologist paying hard cash for any specimens of animal life, from butterflies and snakes to jerboas and porcupines. Besides looking unsuccessfully for blind white fish in cold dark channels the wideawake Mr. Smith notes many aspects of life among the poor and primitive Persians, among them carpet-making and the opium trade.

Miss Engel's book is a scholarly and well-written study of seventeen mountaineers, from J. D. Forbes to Frank Smythe, including Ruskin, who loved mountains but hated climbing, and the undaunted Lucy Walker, who climbed in a white print dress. The writer is particularly interested in the motives that drew people as diverse as Sir Leslie Stephen and Mrs. le Blond, Tyndall and George Mallory, to the tops of mountains. It was their real selves that some sought, far from city clamour, while others were intent on science or peace and beauty in regions where danger forever awaits the careless or unfortunate, as in the tragic venture on the Matterhorn, so often mistold, when Hudson lost his life and Whymper his good name.

John Pascoe's reputation, the well-chosen title quoted from Tasman, and some outstanding photography, slightly mask the mixed and oddly arranged nature of the "New Zealand literary all-sorts" of 'Land Uplifted High.' In the early part certainly, less so later, this reviewer felt much at a loss wading through writing on "the outdoor life," sheep farming and New Zealand topography, with no very clear aim, amid phrases like "nosing around for old

blazes" and the constant and slightly irritating (to the English) use of "swag" and "sidle," both noun and verb, floundering among countless Maori place-names not to be found on any easily available map. L. R. W.

SOME RECENT TRAVEL BOOKS

The first of Sir Arthur Grimble's characteristics to emerge from his book A PATTERN OF ISLANDS (*John Murray*, 18*s*) are his modesty and sense of humour. When he was a very young man fired with a romantic urge to live on the Gilbert Islands in the South Pacific, he had an interview with a senior member of the Colonial Office He sees himself as a coward, without those qualities of leader-ship on which his proud family puts so much stress, and he gives the impres-sion that he passed the interview merely because there were no other young men foolish enough to offer to go to such an outlandish station.

Soon two new facets of his personality appear; determination and courage. The romantic dream of tropical islands and warm moonlit nights is nearly shattered by dysentery, bugs and cockroaches, but he perseveres and finds the dream is fact and worth all the rest. One incident out of many can attest to his courage. While out swimming he meets two islanders who are engaged in octopus hunting. They are working as a team; one man is the "bait" and has to offer himself to the slimy embrace of the octopus, in order that the second man may despatch it with a strong, sharp bite. The way the author describes his gradual realization that he, a bony, unathletic Englishman, will have to take part in the game in order not to lose "face," gives just the right atmosphere of horror. He successfully acts as the bait, though after a few nightmare seconds is almost overcome by nausea.

Sir Arthur Grimble's style of writing is as pleasant as his broadcasting, and this book is recommended unreservedly. Some of the descriptions of octopuses, of vicious man-eating sharks and of lovely starry nights, are echoed by Adrian Conon Doyle in his HEAVEN HAS CLAWS (*John Murray*, 16*s*). This is the account of a journey by yacht in the Mafia Channel in the Indian Ocean, and abounds with exciting stories of sharks and their incredible strength, and the beauty or ferocity of such odd creatures as Manta Rays, Death Rays, barracouda and Jewfish. Apparently the Eagle Ray is equipped with a very sharp protuber-ance like a hollow dagger, and a venom sac. When the weapon is used against men, the victim's flesh inflates in such a flaccid way that if anyone should touch it, dents are left in the skin. The usual result is a slow death. Not all of the incidents in the book are so unpleasant. Again we read of the phos-phorescence on the water of a bay and of the savage charm of islands at night. And again there are things to offset these pleasures; crabs, mosquitoes and centipedes.

But in this case the author's incentive to travel is rather different. It is a restlessness; a determined escape from the unhappy politics of modern life, and a protest against all forms of petty restriction. Adrian Conan Doyle is fortunate that such strong feelings can be translated into action that is so attractively escapist, but there are some embarrassing moments in his writing. In referring to the great authors of the past (whom he calls "the mighty Dead") he mentions that their inspiration enabled us "to peer over their mental shoulders to catch a glimpse of the Great Places through which their imagina-tion swept in ermine and in purple. May God bless and cherish them."

Another cruise in a yacht is taken by Gibson Cowan: THE LOG OF THE PELICAN (*Cresset Press*, 12*s* 6*d*). This time it is the Red Sea, and the emphasis is not on the lives and habits of fish, but of human beings. The author was in

Cairo during the early part of the war, with nothing to do. He answered an advertisement for crew for a yacht going to America, was accepted and told his pay would be £15 a month. His first meeting with a member of the crew, Vaughan, who is clad only in torn silk pyjama trousers, sets the tone of the book, which is full of delightful characterization. Vaughan has "the head of an elderly pirate, bald at the top, with hair standing on end at either side and with a snow-white Captain Kettle beard to match. . . ." Vaughan tells him his pay is to be £17 a month. Then the author meets the Captain, another eccentric, who at that time was doing all the cooking on the yacht, and who puts his salary at £18 a month. But in a few days the Captain appoints him Bosun at £22 a month. Gibson Cowan is at first rather bewildered, and so are we, but he soon gets accustomed to the oddness of his shipmates as the *Pelican* sails up and down the Red Sea, in response to a stream of constantly changing orders given by telegram from the owner. Readers may never quite know what is to happen next, and are not in the least surprised when the author, before very long, becomes Captain. For all this, much grimness and hard work is discernible through the sophisticated, worldly-wise writing.

Very different are INVISIBLE CARGO (*Michael Joseph*, 21s), by Leo Walmsley, and ALASKAN ODYSSEY (*Robert Hale*, 18s), by Father Bernard Hubbard. No sophistication here, as Leo Walmsley shows us his passion for ships and shipbuilding. By chance, he meets a Captain of an oil tanker in a railway carriage, and eventually, at very short notice, manages to get a berth on a tanker bound for the Sargasso Sea, Curaçao, Venezuela and Maracaibo. He gives details of real geographical interest about the finding of oil, its refining, and its complete journey from the ground to the United Kingdom. Everything he meets is new to him, and is carefully if naïvely described, with a wealth of exclamation marks. He communicates his great affection for the sea and sailors (whom he is delighted to hear " yarning") and makes the book an admirable choice for the younger members of a family.

In rather similar vein, but dealing with much colder climates, is Father Hubbard's story of his travels by dog team and aeroplane in Alaska. Known as the Glacier Priest, the author is also part scientist, part mountaineer and part explorer. He flies over an active volcano and is nearly sucked into it, leads small university expeditions to find out more about the effects, temperatures and habits of volcanoes and takes his dog teams many hundreds of miles in the Yukon and Alaska. The author is also a photographer, and the book is unusually plentifully illustrated. The choice of photographs might be a little repetitive, as the same people are photographed several times, but the wild and forbidding scenery, the Eskimos, and the intelligent and often beautiful huskies are worth their place. This book is by a hard-working priest who is not a writer, but if the tale of his journeys does not always hold the attention, the descriptions of such things as the *sounds* made by the Northern Lights, and of a sea-lion's punishment of his mate's infidelity certainly do. I. C.

Her Late Majesty Queen Mary

THE SOCIETY'S NEWS

A ROYAL SOCIETY

On 25 October 1830, Sir Robert Peel (then Home Secretary) announced that His Majesty King William IV had consented to be Patron of the Geographical Society of London. Ever since then the connection between the reigning Sovereign and the Society has been close and continuous, and it is known that early issues of the *Journal* were laid before King William and the little princess Victoria, for their interest and approval. Though at that time the prefix Royal was not included in the title, Sir Robert Peel's announcement was taken as sufficient justification for its assumption, to which the King later consented. Eventually in 1859 Queen Victoria issued a Royal Charter of Incorporation to the Society, in which the words *of London* were omitted from the title.

King William had also placed fifty guineas annually at the disposal of the Society as a Royal Premium for the encouragement of geographical science and discovery. Originally this was awarded in cash, and the first to receive it was Richard Lander in 1832, for exploring the course of the Niger to the sea. But early in 1836 it was decided to use half the Premium for a Gold Medal to be awarded by the King on the advice of the Council. Queen Victoria had however acceded to the throne before the first Patron's Medal had been issued, and a new medal was struck, inscribed to her as Patron, the first Medal being continued in memory of William IV as Founder. Since then the head of each succeeding Royal Patron has appeared on the Patron's Medal. Both it and the Founder's Medal, which are of equal value and of equal honour, have been awarded annually, except for 1943 and 1944.

The history of the Society's Gold Medals traces the highlights of exploration and discovery through the years, and gives point to the reality of the Society's Royal associations. When Edward VII accepted the position of Patron and authorized the continuation of the Royal Medals, he stipulated that no award should be made public until he had personally given his approval to the Council's choice. As Prince of Wales he had always taken a personal interest in the Society, and in 1862 he had succeeded to the office of Vice-Patron, the first holder of which had been his father, the Prince Consort. This was no honorary post, and he attended meetings and performed official functions on a number of occasions. When Captain Speke returned from his discovery of the Victoria Nyanza he gave a lecture to the Society, which His Royal Highness was unable to attend. So Captain Speke read his paper again, at the Royal Institute, in order that the Prince might hear it. In 1869 the Prince accepted an invitation from Sir Roderick Murchison to be present at the Anniversary Dinner, saying "Nothing will interest me more, or give me greater pleasure, than attending the dinner at which you preside. I have taken the greatest interest in the grand project for the exploration of Equatorial Africa." Later, he became Patron of the Society's African Exploration Fund. Also, he visited the House of the Society, when it was in Savile Row in 1890, to supervise details of the Meeting in the Albert Hall which welcomed Stanley after his triumphant return from Central Africa.

But it was not only in Africa that the Prince's interests lay, for he took the chair at the Society's Meeting when Captains Sir George Nares, Stephenson and Markham returned from their Arctic Expedition. A few years later, still as

Prince of Wales, he presided at another Meeting of the Society in the Albert Hall to present a special medal to Nansen, after his expedition to the Arctic in the *Fram*. When the Society held a Meeting to celebrate the fourth centenary of the voyage of Vasco da Gama, he said in his address that he thought it most appropriate that we should join with Portugal in celebrating the fourth centenary of a voyage which had had so marked an effect on the history of the world in general, and of our own country in particular. Then in 1901 he, as King Edward VII, and Queen Alexandra went to Cowes to watch the departure of Lieutenant Scott in the *Discovery*, showing great interest in the ship and its equipment. It was not until January 1907 in the Queen's Hall, that a Royal Patron attended a Meeting of the Society. King Edward was accompanied on that occasion by the Prince of Wales, who was later to be George V, and he addressed the Fellows on the occasion of His Royal Highness the Duke of Abruzzi describing his expedition to Mount Ruwenzori. Two years later the Prince of Wales presented Shackleton with a special gold medal after his return in the *Nimrod*. Edward VII's death in 1910 was mourned as a great loss to the Society, as he had always been its warm friend, ever ready to encourage expeditions and to receive and question returning travellers. At the Coronation of George V, Major Darwin, President of the Society, was invited to represent it in Westminster Abbey, as was Mr. J. M. Wordie, the present President at the Coronation of Her Majesty Queen Elizabeth II. A similar honour was bestowed upon the Society at the Coronation of George VI, in the person of the then President, Professor Henry Balfour, F.R.S. But before this George VI (then Duke of York) had become an Honorary Member in 1924 and at the Society's Centenary in 1930 had presided at the opening of the new buildings at Kensington Gore. At the Centenary Dinner the Prince of Wales (later Edward VIII) addressed the Fellows.

The next Royal visit to the Society was on 5 March 1932, when King George V and Queen Mary were received by the President, Admiral Sir William Goodenough, and officers of the Society. Their Majesties made a thorough examination of the new buildings, museum and collections. Later, the Queen consented to extend her patronage to the Society, and thus for the first time the Society had both reigning sovereigns as Patrons. As a momento of her visit the Queen sent a letter in her own hand and a pair of miniature globes on mahogany stands, which are now in the Map Room. Their date is 1770 and they each have a diameter of about $2\frac{3}{4}$". One is inscribed "A Correct Globe with the new Discoveries" and shows the track of Captain Cook's first voyage.

His late Majesty King George VI who had known the Society from earlier days was Patron, with Queen Mary, for many years, and was succeeded as Patron by our present Queen. The late Queen Mary took a special and personal interest in the Society's well-being, and presented a number of atlases and books to the collections. Queen Mary visited the House informally in 1947 and spent some time in the Exhibition "The World in Focus" and in the Hall where films were being shown to a large audience of children.

At the present time the Society has as Royal Patron Her Majesty The Queen, and an Honorary President in Her Royal Highness the Duchess of Kent. In 1948 the Duke of Edinburgh, as Patron of the Institute of Navigation, which has its offices at the House of the Society, attended a Joint Exhibition of the Society and of the Institute entitled "Navigation Through The Ages." The Duke is also Patron of the British Mount Everest Expedition, 1953, and received the leader, Colonel John Hunt, before his departure. This is in keeping with the ancient tradition of interest in expeditions, dating from 1833, when the Secretary of the Society was received at Kensington Palace, with Captains

Beechey and Back. On this occasion the latter explained the route he proposed to take in search of the Ross Expedition.

So the long unbroken story of Royal Patronage from William IV is brought up to date, with the achievements backed by Royal encouragement in the past giving grounds for hopes of equal attainment and sympathy in the future.

MEDALS AND AWARDS, 1953

Her Majesty the Queen has approved the award of the Royal Medals as follows: *The Founder's Medal* to P. D. Baird, Director of the Montreal Office of the Arctic Institute of North America, for his explorations in the Canadian Arctic; *The Patron's Medal* to Count Eigil Knuth, leader of the Danish Expedition to Peary Land 1948–50, for explorations in northern Greenland and for his contributions to Eskimo archaeology. The Council have awarded *The Victoria Medal* to Sir John Myres, Emeritus Professor of Ancient History in the University of Oxford, for his contributions to the geographical history of Greek lands and for his services to the development of geography in education; *The Murchison Grant* to G. B. Stigant, Hydrographic Department of the Admiralty, for studies and mapping of the Japanese coasts; *The Back Grant* to G. de Q. Robin, senior British scientist on the Norwegian–British–Swedish Antarctic Expedition 1949–52, for geophysical explorations in Queen Maud Land; *The Cuthbert Peek Grant* to Duncan Carse, leader of the South Georgia (Antarctic) Expedition 1952, for exploratory surveys and mapping; *The Gill Memorial* to B. H. Farmer, Fellow of St. John's College, Cambridge, for studies of land use in Ceylon.

GRANTS TO EXPEDITIONS, 1953

The Council has approved grants to eight expeditions in 1953. Of these two are led by undergraduates from the Universities; the Cambridge Langjokull Expedition to study periglacial conditions in Iceland receives £75; and the Durham University Exploration Club's survey at Tindfjallajokull, Iceland, £25. Three expeditions are led by one or more graduates; Nottingham University's grant of £100 will be for geomorphological, glaciological, topographical, geological and meteorological observations in south-east Iceland; the Oxford University Exploration Club's £125 will be for village surveys and botanical and ecological studies in Uganda; with a further £75 to the same Club's expedition to west Spitsbergen, where research will be done on equipment, mapping, glaciology and geomorphology. Three individual graduates are given grants to work on specific problems; D. J. Atkinson receives £40 to study anomalies in the geology of the Hecla Hoek rocks and to complete the mapping of certain raised beaches in north-west Spitsbergen; J. G. Esplen £25 for a social and economic survey of the Lake Tana region in Ethiopia and an examination of the origin of the lake itself; and Professor Alan Rose £45 to investigate a possible porterage route north-east of Narvik in connection with a study of Ohthere's 'Northern Voyage.' The Council has also given its approval to Durham University Exploration Club's expedition to Norway to study geology, botany and zoology, and has agreed to the loan of survey equipment to the University of Sheffield's detailed geological investigation of the upper part of Mount Kilimanjaro.

DIRECTORATE OF MILITARY SURVEY

Brigadier J. C. T. Willis, C.B.E., has been appointed Director General of the Ordnance Survey. His successor as Director of Military Survey will be Brigadier L. F. De Vic Carey.

THE WAVERLEY COMMITTEE

It was announced recently that Professor J. A. Steers had been appointed a member of the Committee on Coastal Flooding, which is under the Chairmanship of Lord Waverley.

GEOGRAPHICAL ESSAY PRIZE

The prize of £10 is offered each year for either a critical survey of recent additions of knowledge in a limited geographical field or a discussion of some current problem in its geographical aspects. Candidates must be registered students reading geography at a university of Great Britain or Northern Ireland during the academic year in which they submit the essay. Essays submitted for the next award must reach the Director and Secretary by 15 January 1954. The Council reserves the right to publish or to retain for the Library any of the essays submitted for this prize.

THE RECORD

CONTRIBUTORS TO THIS ISSUE OF THE *JOURNAL*

Eric Shipton is a distinguished mountaineer and traveller who was awarded the Society's Gill Memorial in 1935 and the Patron's Medal in 1938. *G. W. Murray*, who was awarded a Gold Medal by the Society in 1936, was formerly Director of the Topographical Survey of Egypt, and is now retired. *G. de Q. Robin* is an Australian who holds an I.C.I. Research Fellowship at the University of Birmingham. He has been awarded the Back Grant for 1953 for his geophysical studies during the Norwegian–British–Swedish Antarctic Expedition. *F. Kingdon-Ward* is a botanist and author of numerous travel books. He was awarded the Cuthbert Peek Grant for 1916 and 1924, and a Gold Medal in 1930. *W. B. Fisher* is Senior Lecturer at the Department of Geography, Aberdeen University, and was previously British representative on a U.N.E.S.C.O. panel of Consultants for Scientific Subjects. *Captain H. Lovegrove*, R.N., is a resident and Freeman of Winchelsea. *T. Girtin* is a Liveryman of the Clothworkers' Company, where one of his duties is to carry out research into the history of the Company. *Professor C. A. Cotton* has been Head of the Department of Geology at Victoria University College, Wellington, New Zealand, since 1909, and is well known for his writings on geomorphology. He was awarded the Society's Victoria Medal for 1951.

THE CENTENARY OF CECIL RHODES

The centenary of Rhodes falls at a time unpropitious for his fame. The term "Empire Builder" is not much used or applauded now, and Rhodes' vision of a white man's Africa has ceased to be fashionable without becoming romantic.

Cecil John Rhodes, the son of a parson, was born at Bishop's Stortford on 5 July 1853, and early conceived an enthusiasm for the Empire. He went to Africa when little more than a boy and early proved his ability both at organizing men and at making money. Once the foundation of his fortune was laid in the diamond fields at Kimberley, he became more and more involved in politics, yet his militant dream of British expansion in Africa took an increasingly practical form. His sorties and sallies into the interior were ably led by the type of pioneer traveller whom the great man at the centre knew well how to choose and to fire with his own enthusiasm.

Rhodes was the natural heir to the golden age of African exploration, the era of the true discoverers like Bruce, the crusaders like Livingstone, the naturalists, the hunters, the geographers—men with little idea of settlement and none of gain. To Rhodes, with his resources and his ambition, fell the task of consolidating what his forerunners had found, and he shrewdly picked on F. C. Selous, a medallist of the Society, to lead his Pioneer Column into Mashonaland in 1890.

Rhodes was not a geographer himself, but the writer of his obituary in the *Journal* for May 1902 observed rightly that "the important share which he took in the furtherance of geographical work is not to be wondered at." Under the sway of the British South African Company, formed in 1888 to exploit the new territories annexed by Rhodes, detailed surveys began to take the place of the solitary routes plotted by Livingstone and illustrated by the vigorous sketches and paintings of Thomas Baines. Speaking to the Society on 17 April 1916, Wilson Fox alluded to the financial and practical support given by the Company to the work of the Geodetic Survey carried out over Rhodesia, and it is by such practical results of his policies that geographers may best remember the energetic builder of Empire who sleeps among the Matopo Hills. D. M.

SYMPOSIA ON THE BIOLOGY AND PRODUCTIVITY OF THE SEA

A Symposium on "Certain Aspects of Physical Oceanography" will be held at the Society's House (Exhibition Road entrance) on 17 September 1953. This will be followed, on 18 and 19 September, by a Symposium arranged by the Institute of Biology on the "Biology and Productivity of the Sea." Details of the programmes are on p. iii of the *Journal*.

Attendance at both the Symposia is open without charge to Fellows of the Royal Geographical Society on production of a membership card. Tea will be provided each day without charge. Arrangements have also been made for lunches to be provided at a cost of 4*s* a head at Ayrton Hall Refectory, Imperial College of Science, for those who take tickets in advance. Applications for these tickets must be made to the General Secretary, Institute of Biology, Tavistock House South, Tavistock Square, London, W.C.1, stating for which days tickets are required and enclosing remittance.

Persons who are not members of the Royal Geographical Society or of the Institute of Biology may obtain tickets (price 15*s*) on application to the Institute of Biology. If lunch tickets are also required they may be obtained at the same time by enclosing the necessary remittance.

ELECTRICITY IN THE REPUBLIC OF IRELAND

R. F. Browne, Chairman of the Electricity Supply Board for Ireland, has recently published a careful study[1] of its work which may be of interest to a wider public. Shortly after 1922, the (then) Irish Free State built a new power station on the river Shannon, at Ardnacrusha, to the north of Limerick. This Shannon scheme was built by Siemens-Schuckert. At first it was feared that the enterprise was over-ambitious, but the programme of industrial expansion (especially after 1932), the cost and scarcity of imported coal, and recently the effort to carry electric supplies along every road in the countryside, all have meant increased demand. In effect, electricity supply has been nationalized by the purchase of various local power stations; but the greater part of Co. Donegal

[1] R. F. Browne, "The Electricity Supply Board," *Journal of the Statistical and Social Inquiry Society of Ireland*, vol. 18, 1951–2, pp. 564–82. The Board publishes annual reports illustrated with maps and photographs at its head office, 27 Lower Fitzwilliam Street, Dublin.

has not yet come under the Board's administration. In 1951, the Ardnacrusha scheme had a generating capacity of 85 million watts out of a total of 355 million watts in the country's eight working stations. The Liffey has been tapped by making reservoirs which hold half the total flow for a year and the Erne has now also been used. This last scheme has been made possible by cooperation with the government of Northern Ireland, and eventually some power will be supplied to Northern Ireland. In all, these waterpower schemes now provide approximately half the power available in the country. Sedulous efforts have been made to find other suitable rivers which will be harnessed in due course, but the three so far used have more than two thirds of the available water power.

Imported coal is costly but it is brought direct by sea to the Pigeon House station in Dublin bay, which can generate more than a quarter of the country's power. There is also a small oil generating station at Dublin, and a still smaller coal burning station in Cork. The most interesting development has been the use of peat at Allenwood, Co. Kildare and Portarlington, Co. Leix, which together provide almost a fifth of the generating capacity. These two stations use peat, cut in sods by machines and dried until the water content has dropped from the 90 per cent. it possesses at cutting to 30 per cent. Manual labour is needed for cutting drains, collecting the sods and conveying them to the generating plant, but work on a peatbog is not the most attractive of occupations. Other sources of supply have not proved practical: winds appear to be too uncertain even in the west of Ireland and the harnessing of tides is too costly.

The effect of these schemes is seen everywhere: in 1931 there were 69,000 consumers; in 1951, 343,000. As yet, only a third of the units sold are bought by industrial consumers, which is a far lower proportion than in many other countries: it is hard to see if there will be any substantial increase of demand for industrial purposes, though the use of electricity has made it possible to establish industries throughout the country. The present efforts to carry electricity everywhere involve the erection of 60,000 miles of line for 280,000 potential consumers, and so far a quarter of this mileage of line has been completed. The dispersion of Irish farmsteads, the restriction of cultivated land in many parts of the country to small scattered patches of ground moraine approached by bog roads, all account for the great length of line in proportion to the number of users. And, as Mr. Browne has said, "to entice the farmer proper to realize what advantages he could gain from a liberal use of electricity has involved considerable propaganda work." It has also involved subsidies to reduce the cost of connecting remote places. It has been shown that many farm processes are economically carried out with power, including water pumping for the farm kitchen, and electricity on the farm can alleviate the problems that arise from the continuing decrease of manpower in rural Ireland. But whether these schemes can, as Mr. Browne suggests, do something to arrest emigration by attracting industry to the countryside and by reviving its dying crafts, no one can say. T. W. F.

INSTITUTE OF BRITISH GEOGRAPHERS

After an interval of five years the Institute of British Geographers returned to London for its annual conference, which was held at Bedford College, Regents Park, from 1 to 5 January 1953. The attendance of over two hundred was a record. A wide range of research papers were read and discussed, and, as usual, time was also devoted to field studies. The Royal Geographical Society generously acted as hosts for a joint session with the Geographical Association

at which Professor H. C. Darby lectured on the relations of geography and history before a large audience. At a Sunday evening session Mr. Gresswell presented a lantern display of colour photographs taken by members of the field party who visited western Ireland in September 1952, and a commentary on photographs of valley slope development, taken by Mrs. Joyce Gifford on Exmoor after the storm of 15 August 1952, provoked an interesting discussion.

At the Annual General Meeting Professor R. Ogilvie Buchanan was elected President for 1953 in succession to Professor Alan G. Ogilvie, and Professor Wilfred Smith was elected to the new office of Vice-President, from which he will succeed to the Presidency in 1954. An invitation has been accepted to hold the next annual conference, which will again be residential, at the University College of North Staffordshire, Keele. A. E. S.

GEOGRAPHY AND ADMINISTRATION

An article interesting to geographers has been written by V. D. Lipman in the Autumn 1952 number of *Public Administration*.[1] It summarizes the technique developed in recent years of defining the different grades of urban and rural centres and their respective areas of influence, and refers to articles by E. W. Gilbert in the *Geographical Journal* [2] and *Public Administration* [3] and to the work of Professor R. E. Dickinson, A. E. Smailes, F. H. W. Green and H. E. Bracey in Great Britain, while acknowledging pioneer research in the United States and Germany.

Though Mr. Lipman appreciates the work that has been done and claims that studies of this kind are undoubtedly making a new and illuminating contribution to human geography, he makes a plea to geographers to standardize their terminology. This would help to compare the findings of a survey of one part of the country with those of another. He quotes E. W. Gilbert as pointing to the need for creating new types of units, both large and small, for local government, though he suggests that the association between a service centre and its dependent territory does not necessarily weld the inhabitants of the two into a single community.

In discussing the practical uses of these studies the author mentions the redrawing of administrative areas and boundaries, market research, planning the layout of towns, determining the future distribution of rural population, and the provision of social and educational facilities in rural areas. In this connection, he believes that the evidence of accessibility is the most significant contribution of these studies by geographers to administrators, and that they provide an illuminating background to many administrative problems.

THE ERUPTION OF KELUT

The *Journal for Scientific Research*, the official monthly Journal of the Organization for Scientific Research in Indonesia, contains in its August–September number a study of the eruption of Kelut in Eastern Java in 1951.

The author, M. J. van Yzendoorn, tells of the success of a system of tunnels which had been completed in 1928 to minimize the destructive effects of the eruptions. The necessity for these tunnels had been shown in 1907, when it was realized that the great loss of life and property in previous eruptions had

[1] "Town and Country," *Public Administration*, 30 (1952) 203–14, Haldane House, 76a, New Cavendish Street, London, W.1.

[2] 99 (1942) 78–80.

[3] "Areas of regional organization," 27 (1949) 211–3; Translated into German in *Berichte zur Deutschen Landeskunde*, Band 11, Heft 1 (1952) 150–3.

been caused by the presence of a large crater-lake at the top of the volcano. This was flung out of the crater during every eruption and, with the loose eruption material, formed hot mudstreams which flowed down the hillsides at speed, destroying everything in their way. To prevent the formation of the crater lake, tunnels were dug below the level of the water.

When Kelut suddenly erupted at 6.30 a.m. on 31 August 1951, the tunnels vindicated themselves completely. Seven men lost their lives and the tunnels were badly damaged if not destroyed; but they had served their purpose, and efforts are being made to repair them as soon as possible.

UNIVERSITY NEWS

APPOINTMENTS

The following appointments have recently been announced. E. W. Gilbert, Reader in Human Geography at Oxford and Lecturer in Geography at Hertford College, has been appointed to the Chair of Geography. He will succeed in October 1953 Professor Kenneth Mason, Fellow of Hertford College, who is retiring. Dr. P. R. Crowe, Head of the Department of Geography at Queen Mary College, London, is to succeed the late Professor Walter Fitzgerald in the Chair of Geography at Manchester University.

LONDON MAP COLLECTIONS

A useful guide to the map resources of Greater London has been published by the Reference and Special Libraries Section (South Eastern Group) of the Library Association. The author, Philip de Paris, groups the information in three headings, special map collections, general libraries, and libraries specializing in a particular subject. The list includes national and university libraries, government departments, and public libraries. The general scope of each is indicated, and the conditions under which it is accessible to the public. Of the general collections, it is noted "In spite of certain gaps in coverage it should not be forgotten that, together with the Royal Geographical Society, the British Museum Map Room towers above all the other general collections described here." Among public libraries, the Westminster Central Reference Library is the only one attempting a systematic world coverage, though a number have collections of local or national scope. The special libraries are mainly attached to government departments and are naturally confined to a particular field. As regards foreign geological maps, the sole extensive source is the Geological Museum Library.

The proposal to establish, on a cooperative basis, reference libraries serving more than a single local government area is noted, and reasonable suggestions are made for their basic map stock. A list of sources of information on current maps is also given. Copies may be obtained, price *1s 9d*, from Miss O. T. Smith, 230, Queensway, West Wickham, Kent. G. R. C.

LONDON WEATHER RECORDS

Although a number of weather records of varying length have been established at climatological stations and observatories in and around the metropolis they have never been coordinated, so that it has always been difficult to give unqualified answers to simple questions involving comparison with other places and to select a particular station which would best represent London as a whole. Hence W. A. L. Marshall's 'A Century of London Weather' [1] will be useful in systematizing the various records to some extent and bringing them into focus. The compilation is rigidly statistical without any brief descrptive

[1] Meteorological Office, 508, London, Stationery Office, 1952, *15s*.

notes to make more colourful reading, and notable amid the tabular and diagrammatic matter are the tables showing temperature and rainfall and, since 1880, sunshine for every month in the 109 years 1841–1949; the period 1841–1870 being based on the Greenwich record and 1871–1949 on the Kew series.

On this basis the mean annual temperature of the capital comes out at almost exactly 50° F., and the absolute extremes in the 109 years have been 100° registered at Greenwich on 9 August 1911, and 1° (thirty-one degrees of frost) at Kew on 5 January 1867. The coldest calendar months with a mean day and night temperature of 29°–30° were the December of 1890 and the Februaries of 1855, 1895 and 1947. The warmest months with a mean of 68°–69° were the Augusts of 1911 and 1947, and the Julys of 1859, 1868 and 1921.

Rainfall, to the nearest inch, fell as low as 15 in 1921 and rose to 39 in 1903. It thus appears that London by a wide margin has never experienced anything so exciting as 50 inches of rain in a year, and yet there is many a place in the hilly tracts of England and Wales where an amount as small as this is altogether unheard of! The greatest amount of rain in a day, 4·65 inches in less than $2\frac{1}{2}$ hours, was recorded at Campden Hill, Kensington, in a violent thunderstorm on 16 June 1917. One happens to remember that this storm burst over the city with astonishing suddenness in the middle of a steamy hot day from cumulus clouds which developed *in situ* in a hazy blue sky rapidly becoming black.

Snow is stated to have fallen not earlier in the season than October 19 or later than May 16; but there is certainly an authentic record of it lying in London on 12 October 1887, and also a well-established tradition that on 22 May 1867 the Derby was run in a blinding snow squall.

A section of this work on visibility observations indicates that winter conditions in London have improved during the last fifty years. This is of particular interest as tending to support the impression of those whose memories stretch back to Victorian times that London fogs to-day, however dense they can be, are less black and filthy than formerly, when they used often to bring the complete darkness of night. L. C. W. B.

LAKE SOUNDING RECORDS

In recent years many of the lakes and tarns of the British Isles have been sounded for the first time. Unlike the great surveys at the turn of the century such as the Scottish Bathymetrical Survey by Murray and Pullar and the work of Jehu in North Wales, most of these smaller surveys have been private ones initiated for a limited and special reason, such as the sounding of Corrie tarns to test theories of glacial action. Since it has been seldom thought necessary to publish such work, it is extremely difficult to trace it and the advantages of collecting such information in one centre have recently been pointed out to the Society by M. W. Dybeck, of Jesus College, Cambridge.

The collection of such soundings of lakes and tarns in one place, as is proposed, would prevent duplication, of which there is at least one recent example. The Society, which recently considered Mr. Dybeck's proposal, has therefore agreed to act as the depository for such records with a view to maintaining an inventory of them for reference. The Society would be glad, therefore, if those undertaking soundings of this kind who do not intend to publish them, would send copies of their results to the Map Room of the Society for record. To be of value to other such records they should of course include sufficient information about the datum level from which the soundings were taken, so that possible variations in water level due to draining or damming may be taken into account.

EXPEDITION TO THE NORTH PACIFIC

Unexplored regions of the north Pacific between California and the Philippines are to be studied by an expedition being organized by the Scripps Institution of Oceanography. The primary objectives of the expedition are to make observations on the bathymetry, biology, chemistry, geology, hydrography and meteorology of the area. The expedition proposes to start in the late summer of 1953 and return in January 1954.

IMAGO MUNDI

Imago Mundi, vol. 8, 1951, the review of early cartography edited by Dr. Leo Bagrow, contains the usual variety of topics, ranging from an Italian map of the Balkans probably owned by Mehmed II (1452–53) to itinerary maps of Siberia by the Belgian Jesuit Antoine Thomas, 1690. Among the more notable papers are those of R. Almagià on the work of Francesco Rosselli, co-author of the first engraved world map to include the New World, the unique copy of which is in the British Museum; J. Granlund's discussion of the sources of Olaus Magnus' 'Carta Marina,' 1539; and J. Keuning's analysis of the 'Novus Atlas' of Johannes Janssonius. The latter continues the study of the Mercator-Hondius' atlases by the same author in *Imago Mundi*, volume four. For the complete series, no less than 1094 separate maps are listed. The "south-pointing needle" of the astronomers, in contradistinction to the north-pointing needle of the mariner's compass, is discussed by Professor E. G. R. Taylor, who shows the confusion which arose from not distinguishing clearly between them. The south-pointing needle was used from the fifteenth century in the construction of the portable "compass dials," by which the meridian and the hours of the day could be determined. For the deviation, a conventional figure of 10°–12°, or approximately one point of the mariner's windrose, was widely adopted, until the secular change in the deviation was recognized.

This number is extensively illustrated with reproductions of rare maps, and has numerous notes, reviews, and a comprehensive bibliography for the years 1949–50. Indispensable for the student of early maps, it is distributed by Henry Stevens, Son & Stiles, at $7,00 a copy. G. R. C.

CORRECTION

In the review of 'Climate and the British scene' on page 100 of the March *Journal* reference was made to "the Exmoor cataclysm of August 1950". This should read "August 1952."

SOME AFRICAN MILESTONES. H. F.,VARIAN

The publishers wish to apologize for a mistake on the jacket of this book, which describes Mr. Varian as a Fellow of the Royal Geographical Society and Member of its Committee. It should have read ". . . and member of the Geographical Club."

OBITUARY

GENERAL SIR (FRANCIS) REGINALD WINGATE, *Bt.*, G.C.B., G.C.V.O., G.B.E., K.C.M.G., D.S.O.

With the death of General Wingate there passed away one of the great proconsuls whose services tend to be forgotten by a generation which has seen the peoples of Asia and Africa pass from tutelage to nationhood and independence. His career belongs to an epoch which has passed into history. When as a young subaltern he joined the Egyptian army, Africa was still the dark continent in which the European powers were busy staking out their claims for colonial possessions. The ideal of an empire conceived as the White Man's Burden and as a mission to bring peace and enlightenment to the "new-caught sullen peoples" still seemed worth striving for. In the Sudan the tide of Mahdist victories was running strong, and Wingate had his first experience of active service in the abortive relief expedition of 1884. In the years that followed he made his reputation as a superb intelligence officer patiently piecing together information about the Mahdist state as it filtered through the iron curtain which separated the Sudan from civilization. His 'Mahdiism and the Egyptian Sudan' published in 1891 showed scholarly qualities of a high order, and his knowledge of the country and its people made a decisive contribution to the success of Kitchener's campaigns. After the battle of Omdurman it fell to him to lead the force which fought the final battle against the Khalifa Abdullahi, and in 1899 he became Governor-General of the Sudan "with a clean slate upon which to write" and with powers to administer a vast territory "according to his own almost unfettered will." The affectionate nickname of "Master" bestowed on Wingate by the British in the Sudan indicated the personal character of the regime, but it carried no suggestion of an autocratic temperament which indeed was quite foreign to his nature. In terms of material wealth the Sudan of the first decade of the century was still the "useless possession" which Gordon had declared it to be in 1884, and the success of Wingate's administration can best be appraised against the background of primitive chaos and economic exhaustion from which the country was now beginning to recover. Wingate's understanding of the people whom he ruled and his respect for their religious susceptibilities made him personally popular, and the cooperative attitude of Sudanese leaders during the First World War showed that the administration had the confidence of the people.

When Wingate became High Commissioner for Egypt in 1917 he found a situation which, under the stress of war and with the prospect of allied victory, was rapidly moving towards a crisis. The advice which he tendered during these events was not acceptable to the government in London, and in 1919 there was a disastrous outbreak of violence as a result of which he was superseded by Lord Allenby. In the weighty opinion of the first Lord Lloyd the rejection of his advice was unwise, and the same writer bears witness to "the selflessness and well-known devotion to the public interest" which he displayed after "he had been so unjustly and so discourteously superseded."

This was the end of General Wingate's public career, and in the long years of retirement he retained his deep interest in the Sudan and everything that affected the welfare of its people.

He left behind him a body of published work which, though small, displays him as a discriminating sponsor of the works of younger men. He claimed

authorship only of one other book: 'Ten Years' Captivity in the Mahdi's Camp From the original manuscripts of Father Joseph Ohrwalder' (London, 1892); but he translated and edited R. C. von Slatin's 'Fire and Sword in the Sudan' (London, 1896), and he wrote a number of articles on the events of his own time in the Sudan, besides preparing reports on the defence and administration of the territory. He also wrote introductions to books about Fergie Bey, Count (afterwards Lord Edward) Gleichen, P. F. Martin, Lieut.-Colonel E. C. W. Sandes and C. H. Stigand. He served on the Council of the Society in 1921 and 1922. He never forgot a friend, and all who served under him remember him with gratitude and affection.

JOHN McFARLANE

John McFarlane graduated with First Class Honours in History at Edinburgh and was awarded a Vans Dunlop Scholarship, with which he went as an exhibitioner to Cambridge, where he graduated with Honours in History and Economics. Appointed the first lecturer in Political and Economic Geography at Manchester University he later became Reader in Geography. During the First World War McFarlane served on the Geographical Section of the Naval Intelligence Division and was a contributor to several handbooks then issued. In 1919 McFarlane was appointed Head of the newly instituted Department of Geography at Aberdeen University and was made Reader in 1923, which appointment he held until his resignation in 1945 at the age of seventy-two. Prior to his tenure at Aberdeen McFarlane had close contact with the founders of modern geography in Britain and he owed much, a debt he freely acknowledged, to the teachings of Herbertson and Chisholm. He was a frequent attender, with his wife, at the British Association annual meetings; he was President of Section E at the Cardiff meeting and was a genial host at the Aberdeen meeting.

Head of the Department in Aberdeen, McFarlane never had a whole-time assistant, and alone he maintained the work and kept throughout a lively interest in the studies and concerns of the students who passed through his hands. Perhaps an excerpt from the Resolution of the Senatus Academicus on his retirement best reflects the views of his contemporaries. "For twenty-six years he has discharged the duties of his office, first as Lecturer and, since 1923, as Reader, with zeal, ability and faithfulness. He has by his publications and by his teaching done much to forward the interests of his subject and has earned the confidence and affection of his students. As a member of the Senatus over a period of nineteen years he has, by his quiet wisdom and modesty, his gentleness and sympathy, endeared himself to his colleagues."

Writer of a well-known text in economic geography, the first edition of which appeared before the First World War and the last after the Second World War, and of various articles in which he expounded his views on economic geography, McFarlane maintained the traditions of the Edinburgh school of geographical thought. At the same time he was actively engaged in creating an interest in geography in an area where the subject did not figure appreciably, in the curricula of the schools. It was on his foundation work that the post-war expansion took place.

Situated remote from centres of geographical societies McFarlane was a member of several (he was a Fellow of this Society from 1908 until his death), and united the work of the Aberdeen branches of the Geographical Association and of the Royal Scottish Geographical Society. A. C. O.

COLONEL SIR CHARLES F. ARDEN-CLOSE, K.B.E., C.B., C.M.G., F.R.S.

Colonel Sir Charles Frederick Arden-Close, who died at Winchester on 19 December 1952, in his eighty-eighth year, was the eldest of the seven sons of Major-General Frederick Close, of Shanklin, Isle of Wight. He took the name of Arden-Close in 1938, in compliance with the terms of a bequest. All the brothers, except one who died in infancy, served in the Army; five of them, including Sir Charles himself, in the Royal Engineers. Sir Charles received his commission in 1884, and after completing the course at the School of Military Engineering at Chatham, was sent to Gibraltar where he stayed for about a year before returning to England and joining the balloon detachment. In 1888 he was ordered to India, and the next year joined the Survey of India, in which service he spent the next four years.

He returned to England in 1893, and, two years later, was placed in charge of the survey of the Nigerian–Kamerun boundary. From this work he went on to the Ordnance Survey, and, in 1898, was appointed a Commissioner on the Tanganyika–Nyasaland boundary Commission, a duty which brought him into touch with Sir David Gill and Mr. Cecil Rhodes. On the conclusion of this work Close returned to the Ordnance Survey, but soon afterwards was ordered to the front in South Africa, in charge of a small Royal Engineer Survey detachment. Here, like so many others, he contracted enteric fever, and had to be sent back to England, rejoining the Ordnance Survey as soon as he had recovered his health.

In 1901 he was promoted Major, and the following year became Chief Instructor in Surveying at the School of Military Engineering. While holding this post he prepared his well-known 'Textbook of Topographical Surveying,' which still remains, after fifty years, a standard work on the subject.

In 1905 Close was appointed Chief of the Geographical Section of the General Staff at the War Office, and there took a leading part in securing the establishment of the Colonial Survey Committee. He also took the initiative in getting the British Government to organize the 1909 congress, in London, of the International Union of Geography, at which the working rules for the production of the International Map of the World were finally completed and approved.

Close was elected a Fellow of the Society in 1894, and joined the Council in 1904. He also served as one of the Honorary Secretaries from 1908—in which year he was promoted Lieut.-Colonel—until he became Director General of the Ordnance Survey in 1911. He had hoped, when he went to the Ordnance Survey, that he would be able to restart the geodetic work of that Department, which had been brought to an abrupt and untimely stop by the enforced departure and retirement of Colonel A. R. Clarke in 1881; but the outbreak of war in 1914 interfered with his plans.

Sir Charles retired from the Service in 1922, but continued to devote himself to geographical work and study. He served on the Council of the Society until 1940. In 1927, on the sudden death of Dr. David Hogarth, who had presented him with the Victoria Medal only a short time before, he became the President, holding that office during the celebration of the centenary of the Society in 1930 and during the construction of the new buildings.

Sir Charles married, in 1913, a daughter of Mr. Thomas Percival of Shanklin, and had two sons and a daughter. He was the recipient of many honours and distinctions. At Woolwich he was top of his term, and gained the Pollock Memorial Medal. In 1898 he became a C.M.G.; in 1916, a C.B.; in 1918, a

K.B.E.; and a F.R.S. in 1919. Besides his text-book on topographical surveying, he wrote three books and a great number of articles on various geographical subjects, and he gave the Halley lecture at Oxford in 1914. He was President of the International Union of Geography from 1934 to 1938, and, at various times, President of many other geographical organizations. He was for many years Chairman of the Palestine Exploration Fund, and was an Honorary Member of many foreign geographical societies. As Dr. Hogarth said of him when presenting him with the Victoria Medal, his great knowledge, scientific mind and practical ability made him stand out among geographers all over the world.

M. N. M.

SVEN HEDIN

Dr. Sven Hedin, who died on 26 November 1952 in his eighty-eighth year, was a bold and most ambitious explorer. Before he was twenty-one he had travelled widely in the Caucasus, west Persia and Mesopotamia, and had mastered the Persian language. Five years later he was sent as interpreter with a Swedish-Norwegian diplomatic mission to the court of Nasir-ud-Din Shah at Tehran, where he distinguished himself by climbing Demavend and stealing three human skulls from a Parsee Tower of Silence for the Craniological Museum at Stockholm. The latter feat was typical of him. Once he had made up his mind to attain a particular object, no consideration of other people's feelings, convenience or even safety was ever allowed to deflect him. Not only did he sacrifice ruthlessly his faithful riding and pack animals when crossing desolate wastes, but he deliberately exposed his native companions as well as himself to the risk of a horrible death. His crossing of a 100-mile stretch of the dreaded Takla Makan desert, during which two of his four men and all but one of his camels died of thirst, is one of the ghastliest stories in the history of exploration. On another occasion, on the lofty plateau of north-eastern Tibet, ten out of his twelve horses, four out of his seven camels and one of his men died of cold and hunger.

It must be conceded, however, that he shared every risk with his men, and he certainly got results. In his own words, the adventure and the "conquest" of an unknown country, and the struggle against the impossible, all had a fascination which drew him with an irresistible force. As a result he mapped with remarkable accuracy the main features of vast areas in eastern Turkistan and Tibet, and blazed the trail for the epoch-making archaeological discoveries of Sir Aurel Stein and others. But to him exploration in the field was only half the battle; its results had to be recorded for all time to the glory of Sweden and Dr. Sven Hedin; so between expeditions he laboured indefatigably at his books, which are monuments of industry and erudition. Incidentally, he was a born journalist, and his more popular works are readable to a degree, though marred at times by verbosity and a needlessly assertive temper. He dramatized himself; as if he did not have enough real dangers and narrow escapes to describe, he made adventures out of trivial incidents. His main contributions to geography resulted from his journeys in the Pamirs, the Tarim Basin, and northern Tibet ('Through Asia,' 1898) and in south-western and southern Tibet ('Trans-Himalaya,' 1908, and 'Southern Tibet,' 1922). In the course of these latter explorations he claimed to have discovered the sources of the Indus, the Brahmaputra, and the Sutlej, in spite of the fact that shortly before his visit Major C. H. D. Ryder and the members of the Tibet Frontier Commission had travelled up the Brahmaputra, across the watershed, and down the Sutlej, carrying out a triangulated survey *en route* and mapping the headstreams of the

two rivers. Later explorations have thrown doubt on the validity of at least one of Sven Hedin's identifications.[1]

In 1927 Sven Hedin, at the age of sixty-two, organized and led a large-scale scientific expedition on behalf of his Government to Inner Mongolia, western Kansu and Sinkiang. For six years this amazing man beyond middle age directed the work of an international team of specialists in the field. Not content with this, in his sixty-ninth year he carried out for the Nanking Government a survey of the ancient Silk Road through Central Asia. Then he went home and spent the next twelve years, in spite of increasing blindness, writing up and editing the results in three large quarto volumes (Vols. I–III of the Report of the Sino-Swedish expedition, Stockholm, 1943–45).

By temperament Hedin was a Nazi, to whom exploration was a *Kampf*, a struggle not only against the forces of Nature but also on paper, against rival explorers. It is not surprising that he espoused in turn the causes of Kaiser Wilhelm II and Hitler. The generous help and encouragement he had received from Britain and India—Lord Curzon recommended him for his honorary K.C.I.E. and Lord Kitchener was his intimate friend—were forgotten in 1914 and again after 1933. In the last three or four popular books he published, he betrayed an anglophobe bias and belittled the work of practically all his British rivals except Stein. The Society had awarded him a Gold Medal in 1898 and its Victoria Medal in 1903, but during the First World War his name was removed from the roll of Honorary Members.

These matters should not, however, be allowed to detract from our estimation of his monumental achievements in the field of Central Asian exploration. He was fortunate to live and travel in the last decades of the Golden Age of geographical adventure, and he made full use of his opportunities. C. P. S.

[1] In his paper "The sources of the Brahmaputra, Indus, Sutlej, and Karnali," (*Geogr. J.*, February 1939, p. 126), Swami Pranavananda shows that identification of the sources of these rivers depends on which of three criteria is accepted, *viz.* Tibetan tradition, length, or discharge of water. Sven Hedin used whichever of these criteria suited his purpose. In the case of the Brahmaputra he ignored Tibetan tradition which marks the Chemayundung Chu headstream and its parent glaciers, the Chemayundung and the Angsi, as the source of the sacred river; according to him the Kubi stream, which he followed up to the glaciers at its head, is the source because it carries a much larger volume of water. But when he came to the Sutlej he forgot about the criterion of discharge, according to which the source of this river must be near the Darma pass in the Zaskar range (which he did not visit), and decided that Tibetan tradition correctly regards the Kanglung glacier at the head of the Tage Chu, which falls into Lake Manasarowar from the east, as the source.

Similarly in the case of the Indus, he rejected the claims of the two longest and biggest headstreams, the Lungdep and the Munjam, and accepted the Tibetan view that the Singi-Kabab is the source "in spite" as he himself says "of its being the shortest and one of the smallest of the several source branches." Dr. T. G. Longstaff in a note on the Swami's paper agreed with him in accepting the traditional sources of all four rivers.

CORRESPONDENCE

THE STUDY OF LAKE NYASA

I believe that Fellows of the Society will be interested to hear of some work on oscillation waves which has recently been carried out here by Mr. Jollyman. On a recent visit to Salima I called on Mr. Jollyman at his tiny grass "shack" in a remote cove of the lake. We spent a few hours discussing his records and graphs and, in the end, he asked me to take away his data and make a preliminary analysis of them.

Mr. Jollyman has been in Central Africa for over forty years, and in his professional days was a bacteriological chemist, working in association with research on tsetse fly. Recently, and at an advanced age, he took up the task of reducing the crocodile population of the lake and its outlet, the Shire River, by poisoning, shooting and traps. He has probably accounted for some 3000 of these reptiles, of which he has himself counted 951 corpses.

His camps were at various places along the shore of the lake where he could watch for passing crocodiles and, while doing so, he noticed that certain stumps of trees would appear above the surface of the water at regular intervals as though some kind of a "tide" were operating. He began regular observations last January, gradually improving his apparatus which now consists of a gauge made of 2-inch piping set up in 4 feet of water. A ping-pong ball as float moves an index over a scale which he can read from the door of his hut with a pair of binoculars. His measurements can only be made in daylight and they are subject to many interruptions concerned with crocodiles, so they are far from complete. He carefully recorded wind direction and force, and soon found that they had little influence on the major curves. A full analysis of the curves he drew was quite beyond my powers, even had there been time for it, but certain features are worthy of comment.

An oscillation wave or seiche, such as can be imitated by raising one end of a bath full of water, has certain characteristics which are unmistakable. In its simplest form the node, or line of no wave, will be at the middle section of the bath and the wave will be progressively higher to its maximum at the end of the bath. Further, the rise will be simultaneous along either half of the bath. It is, in fact, a rocking of the whole mass of water about its central section.

In Mr. Jollyman's curves the first characteristic appears quite clearly. At the extreme southern end of the lake he records an amplitude of from 5 to 7 inches. At an intermediate station just south of Cape Maclear it is an inch or so less. At his camp near Salima the wave height has dropped to about 1 ½ inches.

Since the records are made at only a single station at any one time, one cannot say with assurance that the peak of the wave is instantaneous along the coast, but a comparison of the times of "high water" shows that it is probably so.

We have, therefore, a strong indication that there is some type of seiche in Lake Nyasa and, since its amplitude may reach to over 6 inches it must produce a surge effect in the discharge of the Shire itself. It is most desirable to have confirmation of these observations and Lake Nyasa is an excellent lake for the study of a seiche. It runs almost due north and south, so it cannot be subject to any significant tidal effect from the moon, also there are practically no promontories liable to deflect or impede the seiche.

Mr. Jollyman has suspended his crocodile operations owing to the exhaustion of the grant for that purpose, but he would, I believe, continue his "tidal"

observation if he were given any encouragement. There are very few men, even in Nyasaland, with the necessary toughness, training, resistance to fever and eagerness to move up and down this dangerous lake in small craft, setting up a tide gauge in mosquito-ridden coves for a week at a time. What is really wanted is a grant to enable him to continue his work; but grants are hard to get and slow in coming.

In the meantime his greatest lack is a recording clockwork drum and pen which he could attach to his float. He could then obtain records by night as well as by day, and would not have to sit at the door of his grass hut, slapping at mosquitoes, and reading his gauge with binoculars every quarter of an hour.

If there is any Fellow of the Society with sufficient interest in limnology to present such a drum to Mr. Jollyman, I am sure it would be put to full use. Equally valuable would be a letter to him expressing interest in his work, for it can be well imagined that a retired scientist, living under the roughest conditions, in the strangest of places, must feel very cut off though he would scorn to call himself lonely.

He can be addressed c/o District Commissioner,
Salima,
Nyasaland.

It is perhaps somewhat rare for a Vice-President of the Society to have the good fortune to see geographical work being undertaken in a remote place and under most severe conditions. I have no hesitation therefore in recording my gratitude to Mr. Jollyman and in recommending him to the attention of Fellows.

FRANK DEBENHAM

Nysaland,
13 *November* 1952.

MEETINGS: SESSION 1952–53

Meeting of 23 February 1953. The President in the Chair

Elections to Fellowship: Stewart Brumby Beevers; Alfred Joseph Crick; Godfrey A. Chatfield; Frank Duckett, B.SC.; Robert G. Emmett, B.SC.; Major George Fortune, R.E.; William Fraser; Noel Frank Lax; Eric Edward Living; Ernest John H. Lodge; Robert Wade McCallum; Miss Dora Dane McNeill, B.S.; Ronald Frederic Neve; Henry Lawrence E. Newton; F/O E. A. Nicholson, B.SC., R.A.F.; B. Haribhai Patel, B.A.; S. K. Patil, M.P.; E. B. Phillips, B.A.; Miss Margaret O. Pitt, B.A.; The Rev. John Poorter; Miss Muriel M. Rees, B.LITT.; Barrie William Seaton; Leslie Sven P. Welander; Miss Emily F. Whigham; David Alan Willis; Charles A. S. Wilson; Robert Alan Young, B.A.

Elections to Associate Membership: Miss Joyce Chilton; Clive A. G. Hawes; John Holroyd; Michael Robin Hoy; Miss Maren Lockwood; William Alexander McKenzie; Miss Patricia Jane Maguire; Roger Waller; Peter Warner

Paper: Progress of Soviet planning in Central Asia. By Dr. S. M. Manton, F.R.S.

Meeting of 9 March 1953. Mr. Leonard Brooks in the Chair

Film: Western Nepal. Colour films with a commentary by O. Polunin

Meeting of 16 March 1953. The President in the Chair

Elections to Fellowship: Khorshid M. Al Naqib, B.SC.; Miss Kathleen B. Bayliss; John Edward Bradshaw; Audrey Gordon Clook, B.A.; Joshua Bertram Farbridge; Neil Alexander Gordon; Roderic Walter Grosvenor; Miss Alvina G. Hewer; Miss Ruth Mabel Home; Harold Haynes Hood; D. Frewer-Laton; The Rev. Carl McIntire; Francis J. B. Scott Moncrieff; Nwadie Obi Oputa; John C. Phillips; Mrs. Dorothy F. Ratcliff; Flight-Lieutenant D. J. Riaoh, R.A.F.; Ralph Tubbs; John William Tucker; Charles Rowland Twidale, M.SC.; Maximillian John Unwin; Thomas G. Wilkinson; Alexander M. Young

Transferred from Associate Membership: Miss Beryl M. Dyer; Miss Ruth E. Olsson; W. A. Porter; Geoffrey L. Pye; P. A. Richardson; Ernest Richard Rogers; Miss J. E. Shipley; P/O D. F. Wright

Elections to Associate Membership: Maxwell Jonathan Lees; Miss Jill Merriman; J. K. Rose; D. R. Saunders; Miss Evelyn M. Wood

Paper: The Mountains of the Moon. By Professor W. Q. Kennedy, F.R.S.

Meeting of 23 March 1953. Dr. Edward Hindle in the Chair

Paper: Some aspects of problem rural areas in Great Britain. By Dr. G. P. Wibberley

Meeting of 30 March 1953. The President in the Chair

Elections to Fellowship: Major R. St. J. B. Armitage; John Richard Bieneman; The Rev. Arthur Buxton; The Rev. Donald W. Cole, B.A.; Miss Josephine W. Cullen; Frederick St. J. Davies; John Davies; Sir Lloyd Dumas, KT.; Philip W. B. Grahame; B. D. Hilton; James K. B. Ingham, M.B.E., M.SC.; Neville Hugh Jones, B.A.; Mrs. Eloise Dorsey Martin, M.A., LITT.D.; Alexander Matheson; Miss Irene Owen; The Rev. Dr. Walter A. Pegg; Carlyle A. Pushong, B.A.; Dr. Erwin Raisz; V. W. R. C. Lionheart-Richardson; Edmund Frederick Smith; Leslie Smith; John Philip Trant

Paper: Swiss Everest expedition, 1952. By Dr. E. Wyss-Dunant

THE ROYAL GEOGRAPHICAL SOCIETY

Kensington Gore, London, S.W.7

FELLOWSHIP AND ASSOCIATE MEMBERSHIP

The object of the Society being the Promotion and Diffusion of Geographical Knowledge, it has always welcomed to its Fellowship those anxious to further this object by their interest and support, as well as those able to take a more active part in the work of discovery and exploration.

Fellowship

The Bye-Laws provide that a candidate for admission to the Fellowship of the Society must be proposed by a Fellow personally known to him and seconded by another Fellow. Further, that a candidate is not eligible until he (or she) is twenty-one years old, unless he holds a Commission in Her Majesty's Forces or he (or she) is a matriculated student of a University of the United Kingdom or the Self-Governing British Dominions. Proposal forms can be obtained on application to the Director and Secretary.

Every Fellow shall be required to pay on election *either* £4 as Entrance Fee and £4 as Annual Subscription for the current year and thereafter an Annual Subscription of £4 due on 1st January in each year; *or* a single compounding fee of £60.

The Entrance Fee and first Annual Subscription may be paid in four quarterly instalments of £2 each; *or* the Entrance Fee and first two Annual Subscriptions may be paid in four half-yearly instalments of £3 each. Thereafter the Annual Subscription may continue to be paid in four quarterly instalments of £1 each or two half-yearly instalments of £2 each respectively. Entrance Fee and Annual Subscription may be paid by instalments only where payment is made by Banker's Order. Half-yearly instalments shall be due on the 1st January and the 1st July; quarterly instalments shall be due on the 1st January, 1st April, 1st July and 1st October.

For Fellows who are under the age of 25 years on election the Entrance Fee shall be reduced from £4 to £2. The Entrance Fee and first Annual Subscription may be paid in four quarterly instalments of £1 10s. 0d. each *or* the Entrance Fee and first two Annual Subscriptions may be paid in four half-yearly instalments of £2 10s. 0d. each: thereafter payment may be by instalments as above. Entrance Fee and Annual Subscription may be paid by instalments only where payment is made by Banker's Order.

Fellows may compound for their Annual Subscriptions at any subsequent time by a payment of £60 less £2 for each Annual Subscription paid in excess of five with a minimum of £20 after 25 payments.

No Fellow shall be entitled to vote or to enjoy any privilege of the Society while in arrear.

Associate Membership

The Bye-Laws covering the terms of Associate Membership provide that—

1. *A candidate must be not less than 17 and not more than 30 years of age. He (or she) must be recommended by a Fellow, University or School authority.*
2. *Subscription shall be £2 per annum without Entrance Fee.*
3. *On attaining the age of 21 Associate Members become eligible for Fellowship. The Entrance Fee of £2 shall be waived provided they have been Associate Members for 3 years. Otherwise Associate Membership shall cease at the age of 21.*

All subscriptions are payable in advance, on the 1st of January in each year.

Privileges of Fellows and Associate Members

The privileges of a Fellow or Associate Member include admission (with one Friend) to all Ordinary Meetings of the Society, and the use of the Society's House, Library and Map-room. Each Fellow is also entitled to receive a copy of *The Geographical Journal*. Associate Members have the choice of receiving either *The Geographical Journal* or *The Geographical Magazine*. Associate Members may not describe themselves as F.R.G.S. and have no vote at Annual or Special General Meetings.

A pamphlet giving details of the Society and a copy of the Charter and Bye-Laws will be sent on application to the Director and Secretary.

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